Technical Memorandum

Date:	Friday, April 08, 2016
Project:	Stormwater Master Plan Update
To:	City of Cedar Rapids
From:	David Dechant/HDR, Mike Butterfield/HDR, Mike Schubert/HDR
Subject:	TM 4.0 Capital Improvements Plan

This Technical Memorandum provides an overview of the current stormwater Capital Improvements Plan (CIP) and discusses the implications of initial hydraulic modeling results, growth impacts, and condition related needs.

It is organized as follows.

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- Modeling Implications
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    - Kenwood Basin Modeling Implications
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    - B – 304 Storm Sewer Capital Improvements Revised
    - C - NRCS National Soil Database

Objective

The objectives of this Technical Memorandum are to 1) Present the FY 2017 through FY 2021 CIP, 2) provide an order of magnitude estimate of overall City wide stormwater capital needs, and 3) and provide recommendations for the FY 2018 through FY 2022 CIP. The overall magnitude of capital needs will be better defined over the next few years as additional modeling is completed and the asset management program is implemented.

Summary

The FY 2017 Capital Improvements Plan (CIP) includes nearly $50 million of capital needs with expenditures of $2.1 million in FY 2017 and $3.0 to $3.3 million in FY 2018 through FY2021 identified through specific prioritization criteria. Generally, the CIP reflects only capital needs that have been identified to date, primarily in response to flooding in June 2014 and prior studies. Preliminary modeling completed to date indicates that there are likely additional needs not yet reflected in the CIP that will need to be added in the future as additional basin-scale modeling is completed.

The macro model developed for major components in the City's stormwater system and the more detailed basin-scale model developed for one (Kenwood) of the City's 20 watersheds indicate that overall capital needs are likely more extensive than currently identified. Model results suggest that overall capital needs are in the range of $75 to $100 million. With further development over the next few years, the models will be able to fully inform and assist with prioritization of the CIP. Moving forward, the models will also provide a tool to further investigate, consider alternative strategies, and develop and size specific combinations of green infrastructure, detention storage, and conveyance infrastructure to address priority needs.

EnvisionCR targeted growth areas will be served by stormwater infrastructure paid for by the associated development(s). The current CIP does not include expenditures to address future growth related stormwater infrastructure. Due diligence is required on the part of the City to assure that growth related stormwater infrastructure is adequate for future growth in the surrounding watershed in addition to specific developer driven growth. The City should also develop conceptual plans for stormwater infrastructure in EnvisionCR identified growth corridors.

As the existing stormwater system continues to age, capital investment for renewal (rehabilitation and/or replacement) will increasingly be required. While the current stormwater CIP is driven almost exclusively by flooding related needs, it does include $250,000 annually for repair and rehabilitation. As the City continues to refine and implement its Asset Management Program, condition related needs can be more accurately estimated and reflected in the CIP as well. For example, the sanitary sewer system CIP has budgeted an average of $1.6 million per year over the last 16 years for renewal related capital improvements (lining, repairs, and replacement). It is also contemplating a significant increase in this renewal investment out of need moving forward.

The FY 2017 CIP prepared in the fall of 2015 provides the template for preparing the FY 2018 CIP in the fall of 2016. As the budgeting process begins, the prior plan should be updated to reflect anticipated progress in the current fiscal year, adjust anticipated funding levels based on recent changes to the stormwater utility fee structure, reflect basin modeling and planning needs identified herein, review and validate FY 2018 through 2021 projects, and add specific projects for FY 2022. For example, in August 2016, the CIP should be updated to reflect progress made on the Harrison and Rockhurst detention basins, Kenwood and E Avenue basin modeling priorities, growth corridor planning needs, and new/updated stormwater capital needs identified from modeling results and asset management implementation.

Current Capital Improvements Plan & Priorities

The FY 2017 CIP Development TM included as Attachment A presents previously identified stormwater capital needs, prioritization criteria and associated template, and the resulting prioritized capital improvements plan. The total of the CIP projects in the current stormwater CIP is estimated at $48,254,068; nearly $50 million. It includes expenditures of $2.1 million in FY 2017 and $3.0 to $3.3 million in FY 2018 through FY2021.

The current stormwater CIP reflects capital needs that have been identified to date, primarily in response to flooding in June 2014, but in other prior studies as well. The total capital need will likely grow as ongoing hydraulic modeling progresses and as condition related needs are identified and added.

Because of the significant financial need relative to available funding, it is essential that the annual CIP focus on the highest priorities. The prioritization criteria and template used to prioritize capital improvement needs was developed at the outset of the Stormwater Master Plan and modeling efforts. Originally developed by City staff, the criteria and template were refined to reflect similar approaches used by others across the country. The prioritization template provides a qualitative assessment of each stormwater issue or project and yields an objective score and ranking for each. The prioritization criteria and tool is explained in detail in the FY 2017 CIP Development TM included as Attachment A.

The criteria include the following; with weighting factors noted in parentheses:

- Health and Safety (6)
- Cost Benefit (4)
- Current Capacity (6)
- Asset Functionality (4)
- Water Quality & Environmental (2)
- Associated / Other Considerations (3)
- Sanitary Sewer Inflow Conveyance (1)
- Future Growth & Sustainability (3)

It is also important that those needs and priorities be correlated with initial and future model results through continued development of basin-scale models over a period of years. In this manner, the results of each basin-scale model can be used to annually evaluate and update both needs and priorities reflected in the CIP to affirm or justify changes to projects on the CIP and to guide project configuration and sizing. There are two key questions to answer with completion of each basin-scale model:

1. Does the model affirm or show a need for revisions to the prioritization template?
2. Does the model affirm or show a need for revisions to the current list of CIP projects?

Refinements to Prioritization Criteria

Following the initial modeling effort, the prioritization criteria and template were reviewed and confirmed as appropriate. Model results will provide an opportunity to better quantify rather than

qualitatively consider some of the criteria included in the template. Additionally, as basin models are developed over the coming years, both project refinements and additional projects will likely be identified. Using both model output and prioritization criteria will enable projects and issues to be evaluated against a variety of technical and non-technical factors. Further, maintaining the prioritization process – with the addition of the model to help inform the process – will establish consistency in prioritizing projects as basin models are completed.

One way to utilize the model in the evaluation process would be to better assess current system capacity relative to Metro Area Standards and to assess the severity of the problem relative to various storm events. The model can be used to simulate various design storms to assess the extent and severity of surface ponding, the performance relative to design capacity, and how potential project(s) might perform. In identifying which storm might trigger an issue (e.g. surface ponding, bottleneck pipe), the model can show if an asset is functioning as designed.

The Metro Area Design standard for the City's stormwater system address both minor (5 year) and major (100 year) storm events. The standard, as defined in Chapter 2, Section 1.3 of the Design Standards Manual, is to contain and convey the minor storm within the stormwater system, including "underground piping, natural drainage ways, and other required conveyance," and to "prevent major property damage or loss of life from storm runoff expected from the major storm." Toward that end, the model results can be used to assess compliance with the Design Standards Manual and provide input related to the Health and Safety, Cost Benefit, and Current Capacity prioritization criteria as follows.

1. Determining the extent to which transportation corridors are adversely impacted, sidewalks are flooded, emergency access is limited, and property damage occurs as a result of surface ponding with various (1 year, 2 year, 5 year, 10 year, 25 year, 50 year, 100 year, greater than 100 year) storm events.
    - *Applicable Criteria: Health and Safety and Cost Benefit*
2. Determining whether existing pipe segments provide design capacity consistent with Metro Area Standards and to what extent pipe segments become bottlenecked with flows from various (1 year, 2 year, 5 year, 10 year, 25 year, 50 year, 100 year, greater than 100 year) storm events.
    - *Applicable Criteria: Current Capacity*
3. Determining performance of the existing stormwater system under current and future conditions to assess compatibility with targeted growth areas, sustainability initiatives, and development standards.
    - *Applicable Criteria: Future Growth and Sustainability*

Model results provide quantification to supplement qualitative considerations. For example, surface ponding that adversely affects transportation corridors, floods sidewalks, limits emergency access, and causes property damage during smaller storm events should be given greater weight under the Health and Safety and Cost Benefit criteria. Likewise, pipe segments that become bottlenecked during smaller storm events should be given greater weight under the Current Capacity criteria. Finally, projects that provide capacity for targeted growth areas and

are consistent with sustainability issues should be given greater weight under the Future Growth and Sustainability criteria.

The model as envisioned and initially configured does not include a water quality component. Such a component could be added in the future. With a water quality component the model could assess sediment, nutrient, organic, temperature, bacteria, and/or other water quality implications for various (1 year, 2 year, 5 year, 10 year, 25 year, 50 year, 100 year, greater than 100 year) nested storm events. This would make modeling applicable to provide input to the *Water Quality & Environmental* Criteria.

Refinements to Capital Improvements Plan

The current CIP included as Attachment B reflects refinements made over the past six months as additional information has become available. Most notably, those refinements include the following.

Annual CIP expenditures have been modified as follows.

- Annual Miscellaneous Storm Water Projects has been decreased from $250,000 per year to $200,000 per year.
- $25,000 annual expenditure has been added for Stormwater Best Management Practice Cost Share (City cost share for private BMP's).
- $50,000 annual expenditure has been added for Storm Sewer Inlet Modifications (safety guards on storm water inlets).
- $50,000 annual expenditure has been added for Recurring Drain Tile Program, and
- $100,000 annual expenditure has been added for Storm Water Best Management Practices Streets (City green infrastructure projects).

The following project was added to the 304 Capital Improvement List:

- Highway 100 from Edgewood Road to US Highway 30.

The following projects are currently in design and with the addition of FY 2017 CIP funds, these projects are now fully funded (projects highlighted in green):

- Priority Project #1; upstream detention basin near Rockhurst Drive SW at First Avenue within the Morgan Creek watershed.
- Priority Project #2; model and upgrade detention basin west of 11th St NW and south of N Avenue NW.
- Priority Project #5; replace storm sewer on 21st Street SW.
- Priority Project #17; residential buy-out between Sunland Court and Cottage Grove Parkway SE has been completed.
- Priority Project #23; regional detention basin near 18th Street SW south of 16th Avenue.
- Priority Project #51; 2014 FEMA project repair damaged outfall on Ellis Road NW.
- Priority Project #63; 2014 FEMA project replace headwall and wing wall and install riprap near Morgan Creek.
- Priority Project #69; extend storm sewer near Skylark Lane at Red Fox Road SE.

- Priority Project #78; 2014 FEMA project replace storm sewer and reconstruct berm on A Street SW near the landfill.
- Priority Project #81; 2014 FEMA fill and stabilize eroded areas between 38th and 39th Streets SE.

The following projects have been have been completed or have been bid by the City (projects highlighted in orange):

- Priority Project #3; 2014 FEMA project replacing failed culvert on Beverly Road SW.
- Priority Project #4; replace culvert on 27th Street SW north of 29th Avenue.
- Priority Project #8; construct additional intakes and conveyance on Auburn Drive SW north of 16th Avenue.
- Priority Project #9; 2014 FEMA project replacing failed culvert on 20th Avenue SW.
- Priority Project #10; reconstruct outfall for 30-inch culvert near 1521 Hidden Hollow Lane NW.
- Priority Project #16; gabion wall repair on Vinton Ditch at D Avenue.
- Priority Project #20; 2014 FEMA project installation of manhole to remove flood debris at Penn Avenue NW at 1st Street NW.
- Priority Project #21; 2014 FEMA bank restoration project near Lakeview Drive SW north of Beverly Road.
- Priority Road Project #34; repair storm sewer south of Jefferson High School west of 18th Street SW.
- Priority Project #45; construct additional storm water detention at Noelridge Park.
- Priority Project #66; extend storm sewer at Clifton Street NE.

The current 304 CIP Budget for FY 2016 and FY 2017 were revised upwards from $1.7 to $2.35 million and from $2.05 to $2.34 million, respectively, as reflected in Attachment B. The upward revision was a result of spending 304 reserves. The 304 CIP budgets for FY 2017 thru FY 2021 did not change.

FY2017 and FY2018 Projects

The FY 2017 Stormwater CIP identified $13,593,000 of projects for funding in FY2017 through FY2021. Note that $10,770,000 is anticipated to be spent during this timeframe, as not all of the projects will be complete by FY2021. The projects were selected based on project priority – as determined by the prioritization process – and readiness.

Table 1, below, lists projects identified for FY 2017. The Rockhurst Drive and Harrison Basin projects were both consistent with the results of the initial macro-scale Model. The 18th Street SW Detention Basin was included as part of a previous development agreement between the City and a developer. All three projects should be carried forward as planned, along with the funding for Miscellaneous Projects to address anticipated but unidentified repairs and funding for additional basin-scale model development.

Table 1: FY 2017 Storm Water CIP

Project Name	Priority Ranking	Storm Water Issue	Basis for Selection	Multi-Year	Budget
Misc. Storm Water Projects	-	Unidentified repairs	Annual	-	$200,000
Storm Water Master Plan Updates	-	Modeling and Updates	Annual	-	$100,000
Stormwater BMP Cost Share	-	City Cost Share for Private BMPs	Annual	-	$25,000
Storm Sewer Inlet Modification	-	Safety Guards on Stormwater Inlets	Annual	-	$50,000
FY Recurring Drain Tile Program	-	Drain Tile Improvements	Annual	-	$50,000
Stormwater BMP's Streets	-	Green Infrastructure Projects	Annual	-	$200,000
Highway 100 from Edgewood Road to U.S. Highway 30	-		New development	-	$135,000
Rockhurst Drive at 1st Avenue SW	1	Overland and residential flooding within the Stoney Point subdivision	Land for detention basin is currently for sale	2017-18	$880,000
Detention basin west of 11th Street NW and south of N Avenue (Harrison Basin)	2	No suitable overland flow path from the detention basin near Harrison Elementary. Outlet structure from basin does not meet design standards.	Priority ranking and recurring damages.	2017-18	$300,000
18th Street SW Detention Basin	24	Regional detention basin required as part of development agreement	Prior Agreement between Developer and City	No	$400,000
				FY 2017 Total:	**$2,340,000**

Table 2 below, lists projects identified for FY 2018. Numerous projects, many of which had high priority rankings, were identified for the Kenwood and E Avenue basins putting a priority on basin-scale modeling for Kenwood that was included with the Master Planning effort and basin-scale modeling for the E Avenue Basin. Initial modeling results to date are consistent with the FY 2018 CIP as well as the subsequent FY 2019 through FY 2021 CIP.

Table 2: FY 2018 Storm Water CIP

Project Name	Priority	Storm Water Issue	Basis for Selection	Multi-Year	Budget
Misc. Storm Water Projects	-	Unidentified repairs	Annual	-	$200,000
Storm Water Master Plan Updates	-	Modeling and Updates	Annual	-	$100,000
Stormwater BMP Cost Share	-	City Cost Share for Private BMPs	Annual	-	$25,000
Storm Sewer Inlet Modification	-	Safety Guards on Stormwater Inlets	Annual	-	$50,000
FY Recurring Drain Tile Program	-	Drain Tile Improvements	Annual	-	$50,000
Stormwater BMP's Streets	-	Green Infrastructure Projects	Annual	-	$100,000
Gibson Drive NE	6	Detention basins are undersized resulting in overtopping and flooding of yards.	Design, Survey and Sub-basin Modeling	No	$400,000
18th Street SW at 29th Avenue SW Culvert Replacement	7	Existing culvert is aging and is undersized.	Priority Ranking	No	$200,000
Kenwood Sub-basin	11	Sub-basin has collection, conveyance, and detention issues causing local and area wide flooding	17 Projects Identified within Sub-basin - Begin Modeling and Design	2018-?	$400,000
E Avenue Sub-basin	15	Sub-basin has collection, conveyance, and detention issues causing local and area wide flooding	9 Projects Identified within Sub-basin - Begin Modeling and Design	2018-?	$400,000
12th Street SW near 32nd Avenue	25	No overland path results in flooding of business	Priority Ranking	No	$175,000
				FY 2018 Total:	**$2,100,000**

The macro-scale model results did not show issues near the Gibson Drive NE detention basins and 18th Street SW culvert projects. However, the Macro Model examines only larger components of the stormwater system (48-inch diameter and greater), so the associated storm sewer systems for neither were evaluated in the macro model. The priority score for these projects could be confirmed by more detailed evaluations.

FUTURE MODELING EFFORTS

Continued development of basin-scale models is essential for refinement and prioritization of the long-term stormwater CIP. Table 3 is a compilation of the watersheds in Cedar Rapids with the total number of currently identified projects in each. It shows the total dollar value of all projects in the watershed, plus average, maximum, and minimum prioritization scores. In addition, each watershed is ranked by total dollar value and by average priority score. This table provides a guide for prioritizing the order of basin-scale modeling.

Table 3: Number Projects by Watershed

Watershed	No. of Projects in Current CIP List	Total Dollar Value	Prioritization Scores			Rank by Dollar Value	Rank by Average Score
			Ave	Max	Min		
Morgan Creek	5	$1,912,000	54	90	41	8	4
Prairie Creek	10	$3,226,165	57	79	41	6	3
Hoosier Creek	0	$0	-	-	-	-	-
O Avenue	5	$3,315,000	54	79	34	5	5
E Avenue	9	$14,154,204	58	69	45	1	2
Rockford Road	4	$3,580,000	51	59	45	4	7
Czech Village	6	$2,880,368	50	69	34	7	8
Cedar River	5	$399,409	43	59	28	12	11
Cedar River (NE)	1	$10,000	34	34	34	13	13
Ushers Ferry	3	$1,100,000	59	72	34	11	1
McLoud Run	10	$3,740,000	37	48	28	3	12
Kenwood	17	$10,630,000	52	62	28	2	6
Downtown	0	$0	-	-	-	-	-
Cedar River (SE)	6	$1,423,672	45	59	34	10	9
East Otter Creek	0	$0	-	-	-	-	-
Indian Creek	9	$1,613,250	43	62	28	9	10
Squaw Creek	0	$0	-	-	-	-	-
Dry Creek	0	$0	-	-	-	-	-
TOTAL	**90**	**$47,984,068**					

Listed below is the recommended order for completing basin-scale models. The FY 2017 and FY 2018 specifically identify the need for Kenwood and E Avenue basin modeling. The Kenwood basin model continues to be the highest priority for numerous reasons and project development modeling in Kenwood should continue. The basin-scale models that have been developed to-date have shown the critical areas needing attention and a general strategy for approaching issues. The next step for modeling will be to develop projects, including system capacities and sizing for design.

1. Kenwood
2. E Avenue*
3. Prairie Creek

4. Rockford Road*
5. Morgan Creek
6. Ushers Ferry
7. McLoud Run*
8. Czech Village*
9. Indian Creek
10. Cedar River SE
11. Cedar River NE

Watersheds listed with an asterisk have potential secondary benefits with respect to the interior drainage systems associated with the Cedar River Flood Control System, and should be a priority for that reason. The Downtown and O Avenue basin models are not included in the list; the Downtown basin model was developed separately as part of the East Side Flood Control System Project and the "O" Avenue watershed will be modeled in calendar year 2016 as part of the Harrison Basin (11th Street NW) Detention Basin project.

Modeling completed through February 2016 as part of the Stormwater Master Plan has focused on quantity. While water quantity is the more urgent need, water *quality* should be taken into account as future modeling proceeds. At some point, the water quality capabilities of the Innovyze InfoWorks ICM model should be included in future efforts.

Modeling Implications

As the macro model is refined and basin models are completed, the stormwater CIP will be fully informed by hydraulic modeling results. In the meantime, initial macro-scale model results provide an order of magnitude estimate of City wide capital needs with major components of the existing stormwater system. They also provide insight to prioritize subsequent hydraulic modeling efforts. Likewise, the initial Kenwood basin-scale model results provide an order of magnitude estimate of stormwater capital needs in a priority basin. They also provide an approach to use basin-scale modeling to consider various basin wide strategies to identify potentially cost effective and complimentary solutions. Both initial macro-scale and initial Kenwood basin-scale model results are summarized below.

Macro Model Results

Overviews of macro-scale model results are included as Figures 1 and 2. Both are excerpted from and described in more detail in TM 3.1 Macro Modeling. Results from the macro-scale model indicate several areas for which the citywide storm water system does not have the capacity to convey the 5-year rainfall runoff which is the current design standard for the Metro Area.

A workshop with the City was conducted on October 14, 2015, to discuss macro-scale model development and present preliminary results. Generally, the macro model was validated in that many of the areas where the model predicted bottlenecked or surcharged pipe sections were congruent with the City's understanding of their system and with observed areas of stormwater ponding. More particularly, these areas include the 14th St. NE/16th St. NE and A Ave/B Ave area (Kenwood Basin), the main trunk line and Harrison Basin (O Avenue Basin), Rockford Road, and the Czech Village trunk line.

The macro-scale model results indicate that, considering the City's design standard to convey the 5-year storm event in the City's sewer system, there are significant systemic deficiencies in several of the major conveyance elements. Figure 1 identifies elements that are flowing full because they are actual bottlenecks or because they are upstream of actual bottlenecks. More detailed field investigation and modeling of the individual basins are required to affirm limitations, develop concepts, and identify specific projects. However, in the interim, the magnitude of system deficiencies can be estimated at a relative order-of-magnitude level to address conveyance deficiencies identified by the macro model.

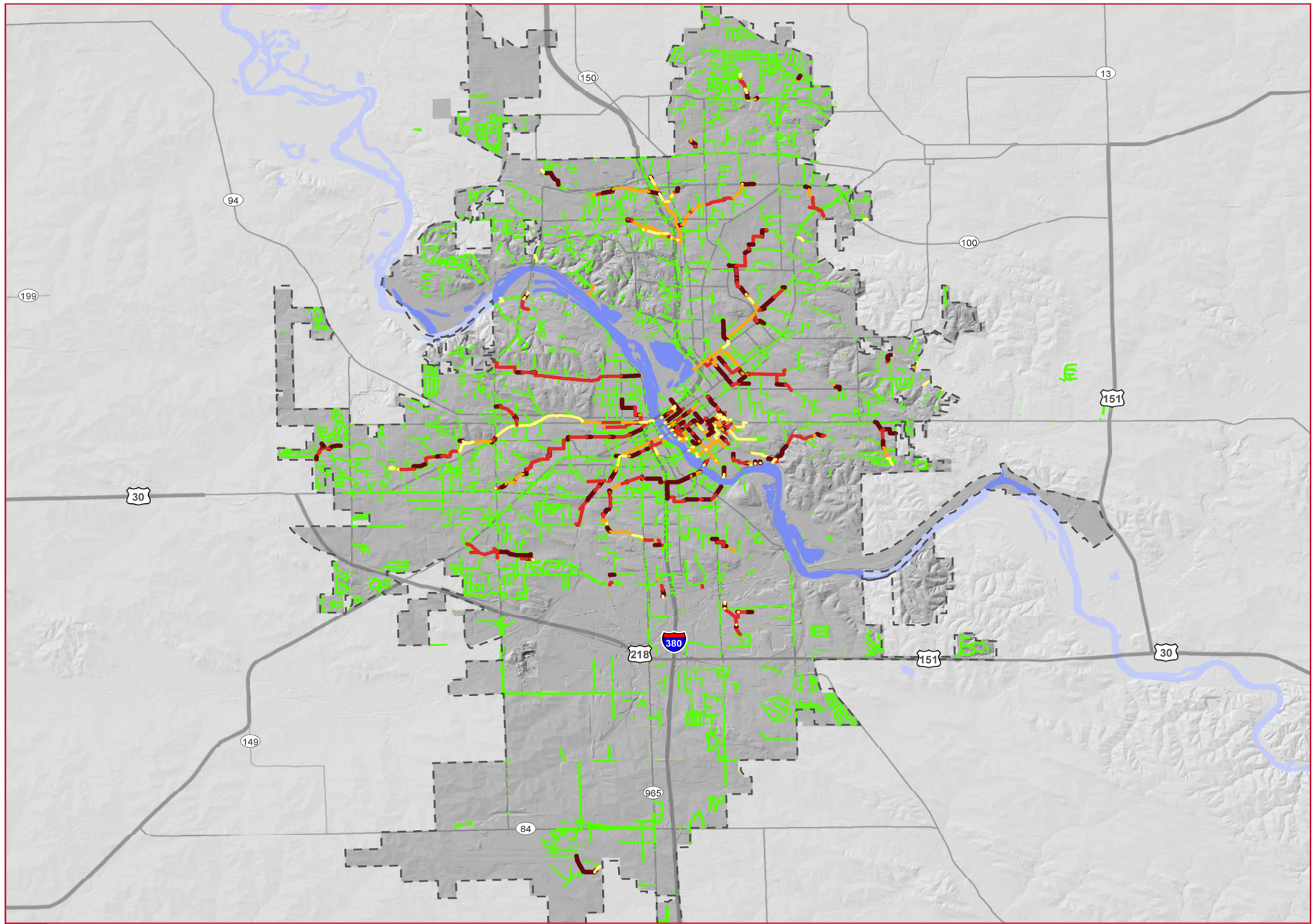

FIGURE 1
CITYWIDE MODEL RESULTS
5-YEAR EVENT

City Boundary
Cedar River
Storm Pipe

Surcharge

Less than half full
More than half full
Full - Bottleneck Downstream
Full - Bottleneck Pipe

0 Miles 1.5

DATA SOURCE: City of Cedar Rapids

HDR CEDAR RAPIDS City of Five Seasons

CITY OF CEDAR RAPIDS
STORMWATER MASTER PLAN

PATH: Z:\PROJECTS\258297-CR STROMWATER MASTER PLAN\MAP DOCS\MXD\CR MODEL RESULTS 5YR CITYWIDE 20151106.MXD - USER: WWHEELER - DATE: 11/9/2015

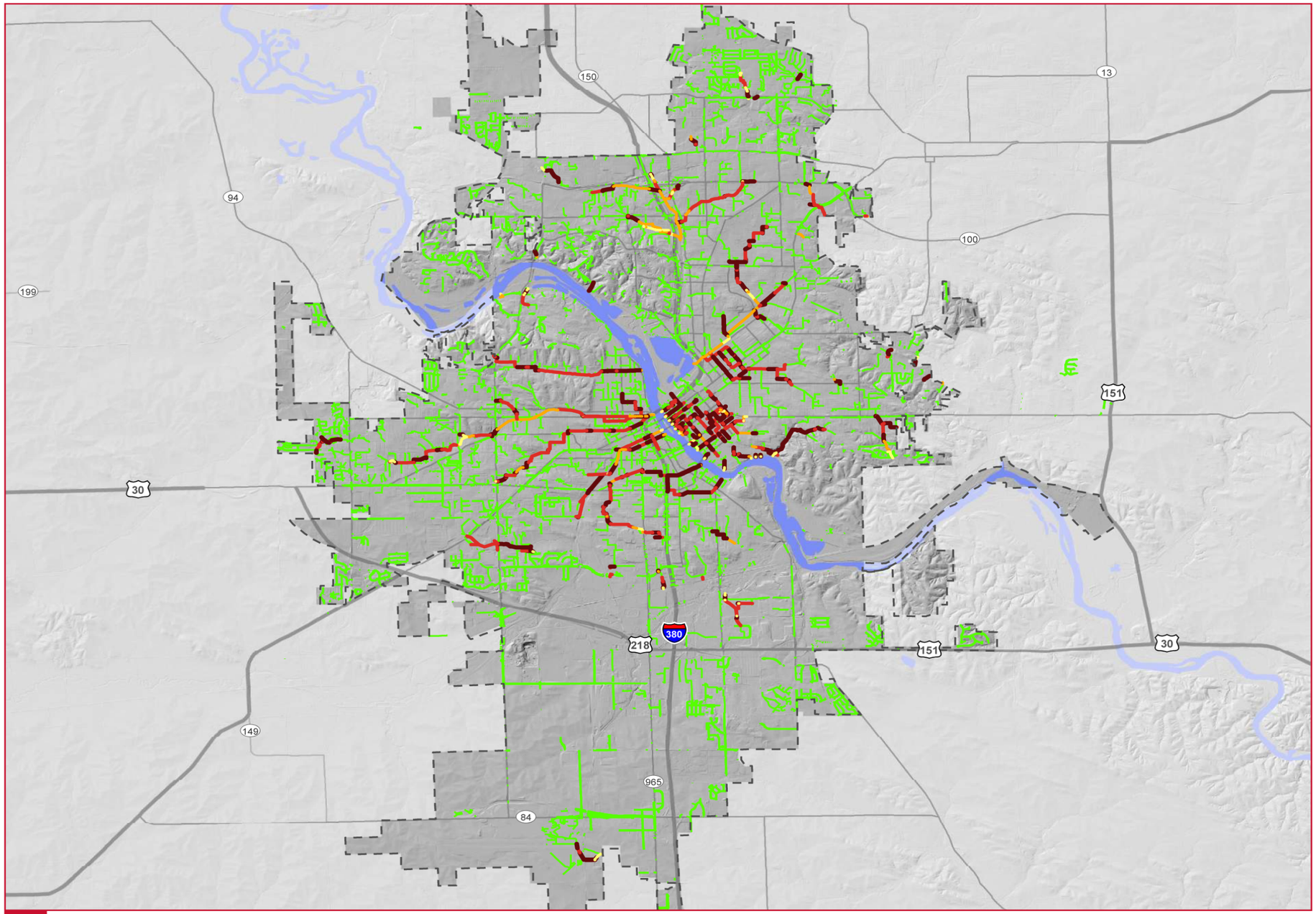

FIGURE 2
CITYWIDE MODEL RESULTS
100-YEAR EVENT

City Boundary
Cedar River
Storm Pipe

Surcharge

Less than half full
More than half full
Full - Bottleneck Downstream
Full - Bottleneck Pipe

0 Miles 1.5

DATA SOURCE: City of Cedar Rapids

HDR CEDAR RAPIDS City of Five Seasons®

CITY OF CEDAR RAPIDS
STORMWATER MASTER PLAN

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Two general strategies can be used independently or interdependently to address conveyance limitations. The first strategy would be to reduce the amount and intensity of runoff to the capacity-limited portions of the system. This can be achieved by detaining water upstream of a bottleneck through larger regional detention facilities or by the collective effect of distributed storage and green infrastructure (GI) / low-impact design (LID). A second strategy would be to simply increase conveyance capacity at the bottleneck portion of the system by replacing and upsizing existing pipes, by paralleling existing pipes if there is space, and/or by adding to the existing storm water system to convey upstream flows away from the bottleneck. The effectiveness and impacts of implementing any of or combinations of these strategies can be evaluated best using a 1D-2D detailed basin model.

ORDER OF MAGNITUDE PLANNING OPINION OF PROBABLE COSTS

An order-of-magnitude estimate of the cost to address macro-scale model identified deficiencies in major components of the stormwater system (48" storm sewers and larger) was developed. Simply to provide an order of magnitude, the estimate was based on the assumption of paralleling all bottlenecked pipes with an in-kind pipe section. Again for simplicity, the cost was estimated based on a planning-level cost approximation of $5/inch-diameter with an additional $20 per linear foot to account for structures and inlets.

Costs were estimated for the seven watersheds with the largest stormwater collection networks. The other 13 watersheds did not have major stormwater conveyance networks comprised of 48" diameter or larger pipes. As shown in Table , the order of magnitude estimated cost for conveyance improvements in these pipe segments alone is roughly $16,000,000. This does not account for any conveyance improvements in pipes smaller than 48" or any storage/detention, culvert upsizing or repair, sewer extension, or implementation of low-impact retrofit. A portion of this total may be included in the existing CIP, but much of the total is likely not.

Table 4: Macro-Level Conveyance Improvements Planning Costs

Basin	Pipe total	Structures total	Total
O-Ave	$ 679,000	$ 34,000	$ 713,000
E-Ave	$ 2,973,000	$ 166,000	$ 3,139,000
Rockford Rd	$ 1,199,000	$ 67,000	$ 1,266,000
Czech Village	$ 3,243,000	$ 185,000	$ 3,428,000
Kenwood	$ 4,039,000	$ 269,000	$ 4,308,000
McLoud Run	$ 1,208,000	$ 80,000	$ 1,288,000
Downtown	$ 1,601,000	$ 270,000	$ 1,871,000
		Grand Total	**$ 16,012,000**

FUTURE CONSIDERATIONS

The prior section identified priorities for subsequent basin-scale modeling based on the number and dollar value of previously identified projects and implications on the proposed Flood Control System. The macro-scale model results are an additional indicator of which basins should be priorities for future detailed basin modeling. Macro model results indicate where Cedar Rapids

may have the greatest stormwater conveyance deficiencies and may need the most complex strategies to address these issues.

Subsequent basin-scale modeling can identify the best basin wide solutions; likely a combination of reducing the amount and intensity of runoff to the capacity-limited portions of the system and providing additional conveyance capacity. Detailed modeling provides a tool for identifying the catchment areas and the mitigation strategies that can be implemented to address local and cumulative stormwater management issues.

Kenwood Basin Modeling Implications

Detailed basin-scale models, which simulate ponding, overland flow, and a more extensive pipe network (12" and larger), will ultimately be developed for each watershed in the City to enable evaluation of mitigation strategies in the context of the entire system. The models provide sufficient detail to replicate observed conditions for various storm events and to develop mitigation strategies for design storm events. At the October 14, 2015 workshop, it was decided that the Kenwood watershed was the highest priority critical basin scale model to develop. A 1D/2D hydrologic and hydraulic model was developed for the Kenwood basin to evaluate system performance during the 5-year and 100-year nested rainfall events.

Overviews of Kenwood basin-scale model results are included as Figures 3 and 4. Both are excerpted from and described in more detail in TM 3.2 Basin-Scale Modeling - Kenwood. These preliminary model results identifying bottlenecks and ponding areas along with approximate ponding depths were presented and discussed with City staff on December 9, 2015.

In general, City staff was able to confirm that both the location of ponding and the approximate ponding depths predicted in the model were reasonable given the observed ponding during the June 2014 flash flood event; thereby generally validating the model. Also, predicted flooding from the Kenwood basin model is consistent with projects in the current stormwater CIP and customer complaints (debris, storm, and basement backup incidents) documented from the June 2014 storm. Furthermore, previous historic events (1971, 1993, and 2008) noted flooding and damage issues in the same areas of the flooding shown in the model results.

Watershed Strategy Development

Kenwood basin-scale model results shown in Figure 3 for the 5-year rainfall event were used to consider alternatives and develop a preliminary stormwater management strategy for the Kenwood Watershed. The strategy was developed systematically, based on a logical evaluation of model results in 20 project area basins within the Kenwood Watershed. Project area basins were delineated at and upstream of locations which exhibited significant bottlenecks or surface ponding in the results from the 5-year rainfall model. These project area basins are shown in Figure 5 along with projects in the current CIP noted with stars and case numbers.

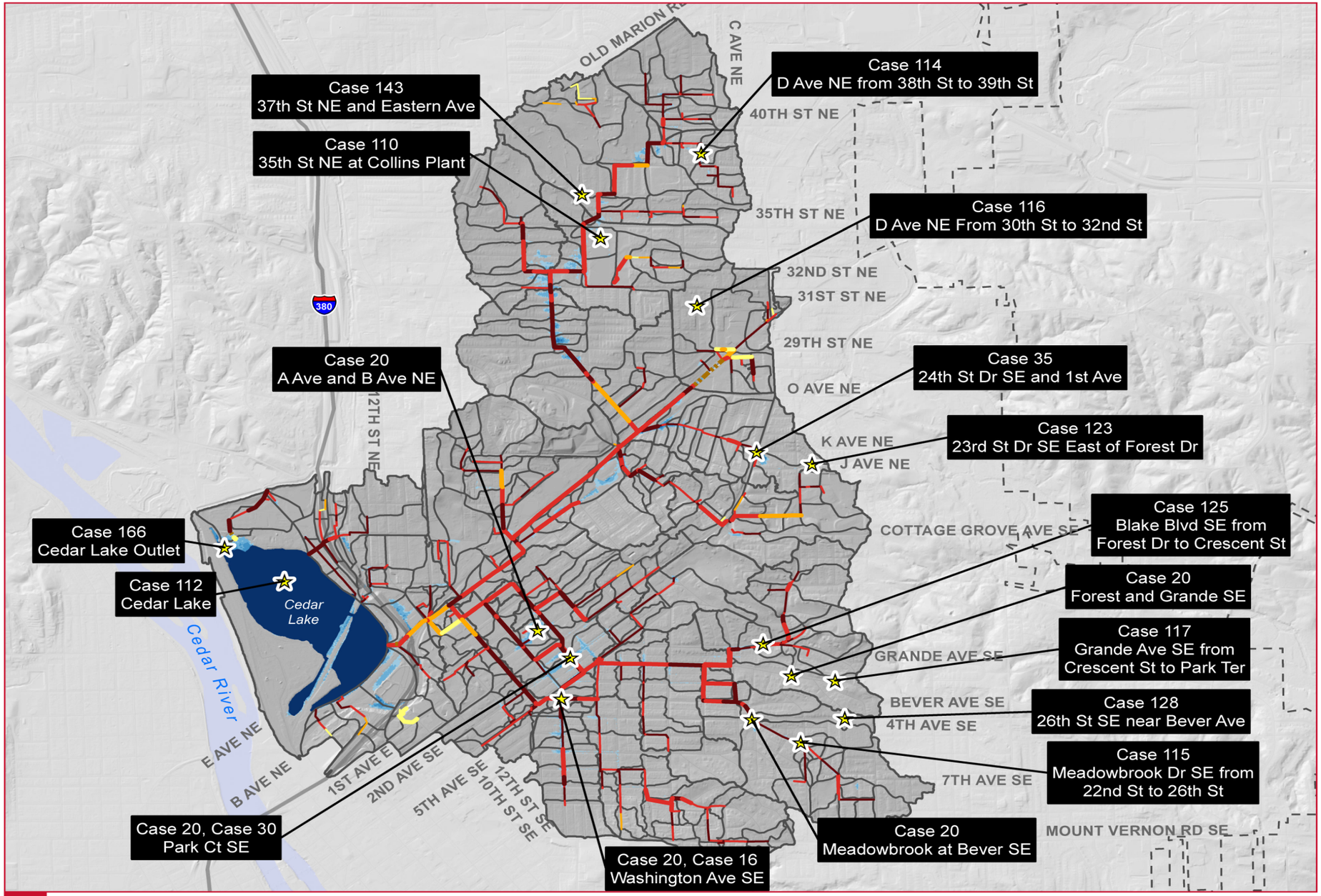
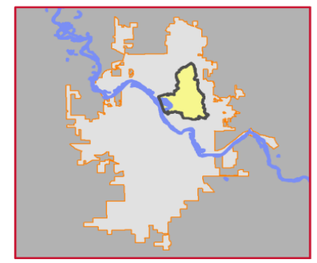


FIGURE 3
5-YEAR MODEL RESULTS
KENWOOD WATERSHED

- CIP Project Location
- City Boundary
- Cedar River
- Catchment
- Sub Catchment
- Open Channel

Surcharge
- Less than half full
- More than half full
- Full - Bottleneck Downstream
- Full - Bottleneck Pipe

Ponding Depth (ft)
- 0.5 - 1.0
- 1.1 - 2.0
- 2.1 - 3.0
- 3.1 - 4.0
- 4.1 - 5.0
- 5.1+



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DATA SOURCE: City of Cedar Rapids

HDR CEDAR RAPIDS City of Five Seasons

CITY OF CEDAR RAPIDS
STORMWATER MASTER PLAN

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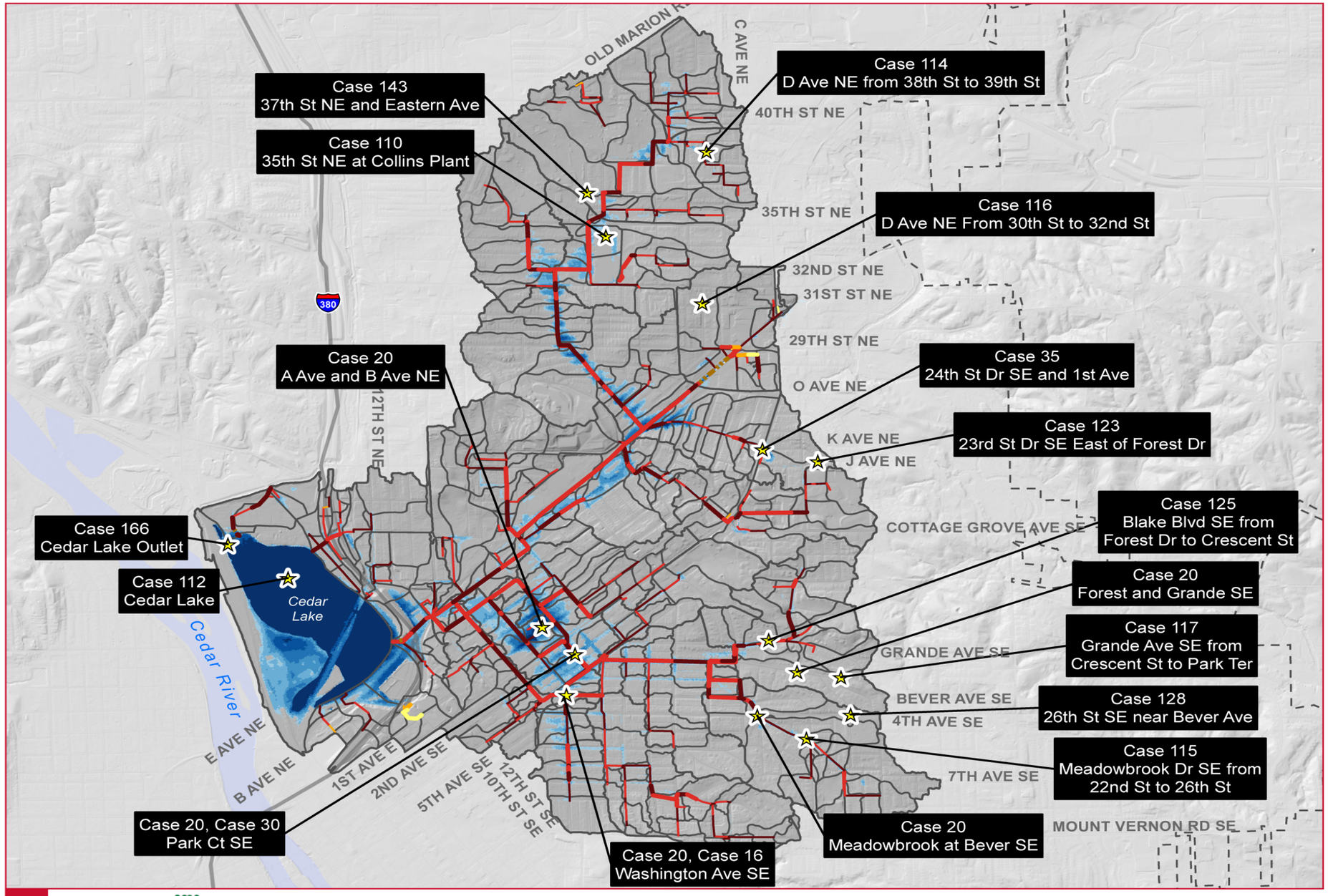


FIGURE 4
100-YEAR MODEL RESULTS
KENWOOD WATERSHED

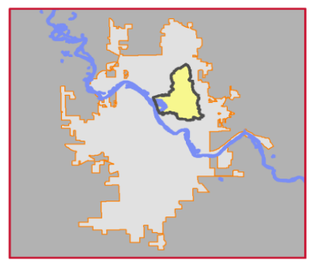
- CIP Project Location
- City Boundary
- Cedar River
- Catchment
- Sub Catchment
- Open Channel

Surcharge

- Less than half full
- More than half full
- Full - Bottleneck Downstream
- Full - Bottleneck Pipe

Ponding Depth (ft)

- 0.5 - 1.0
- 1.1 - 2.0
- 2.1 - 3.0
- 3.1 - 4.0
- 4.1 - 5.0
- 5.1+



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DATA SOURCE: City of Cedar Rapids

HDR CEDAR RAPIDS City of Five Seasons

CITY OF CEDAR RAPIDS
STORMWATER MASTER PLAN

PATH: Z:\PROJECTS\258297-CR_STROMWATER_MASTER_PLAN\MAP_DOCS\MXD\TM_3\MICRO\CR_KENWOOD_100YR_RESULTS_20151231.MXD - USER: WWHEELER - DATE: 1/7/2016

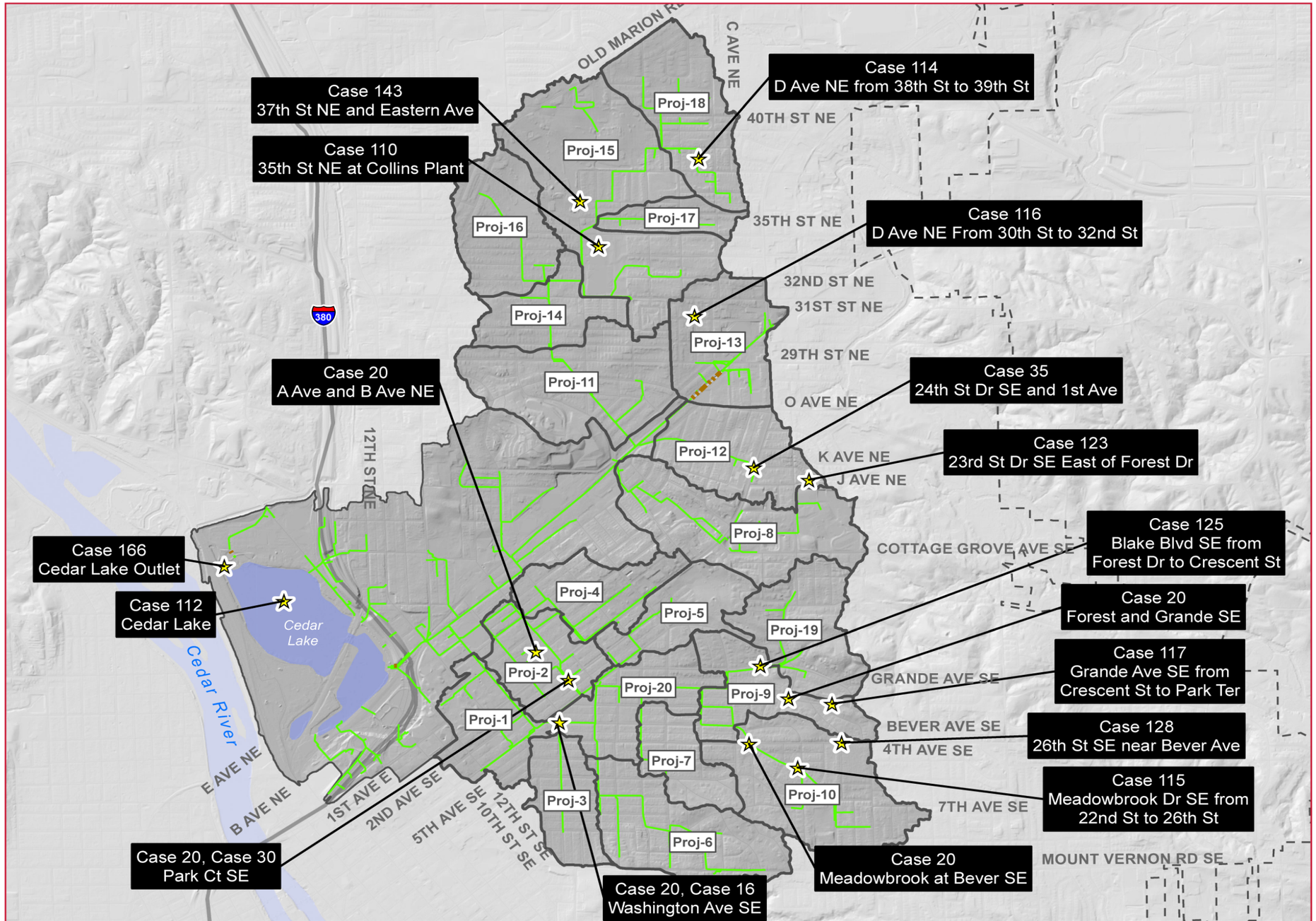
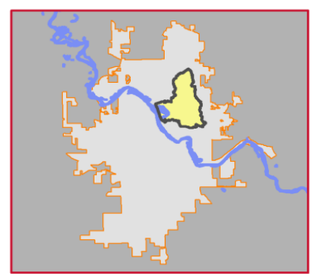


FIGURE 5
PROJECT AREA CATCHMENTS
KENWOOD WATERSHED

- CIP Project Location
- City Boundary
- Project Area Catchment
- Proj-X Project Area Catchment ID
- Cedar River
- Storm Pipe
- Open Channel



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DATA SOURCE: City of Cedar Rapids

The process, which was presented to the City at a workshop on January 27, 2016, prioritizes strategies that reduce the amount and intensity of runoff through storage and/or green infrastructure, considers the effectiveness in reducing stormwater management issues downstream, and then mitigates remaining issues through conveyance improvements. In other words, it categorizes strategies as green infrastructure, local distributed detention, regional detention, and conveyance improvements with an emphasis on the first three. The process was developed around the Kenwood basin but ultimately will be applied as the foundational philosophy for remaining watersheds.

GREEN INFRASTRUCTURE

Green infrastructure (GI) would include a number of retrofit measures that reduce runoff and increase infiltration, including bio-retention, permeable/green pavement, and downspout disconnections. The measures would have the added benefit of improving water quality. For this preliminary screening, areas where GI would be most effective in reducing runoff volume were characterized as having a high percentage of impervious area (>30%) and a significant amount of hydrologic soil types A or B (greater permeability). For this evaluation, it was assumed that areas with these characteristics could experience a runoff reduction of one inch over the project area basin through GI implementation.

LOCAL DISTRIBUTED STORAGE

Local distributed storage was considered to account for the possibility of incorporating any depressions or structures intended to capture local runoff. These would include local detention ponds, swales, depressions, or underground storage. Each could provide a reduction in flow and volume with an added water quality benefit. Areas where implementing these strategies would be most feasible were identified as having greater than 1% of the entire area as city owned land or parks or large (>3 acre) parcels with significant (>50%) impervious areas. This strategy would be most suitable in basins with a conveyance constriction downstream, so this was considered as well. For a volumetric evaluation, an estimate was made that 25% of land suitable for local distributed storage retrofit could be converted to capture 4 feet of water (1 acre-foot per acre of suitable area).

REGIONAL DETENTION

Regional detention is included to account for the potential to construct a large detention facility that would collect and store stormwater runoff from several basins to reduce peak flows to alleviate a downstream issue. Configured properly, regional detention would also provide a water quality benefit. Areas where such a facility would be constructed were identified as large (<10 acre) open spaces with a significant bottleneck downstream.

CONVEYANCE IMPROVEMENTS

Areas for conveyance improvements were identified based on magnitude of conveyance capacity deficiency and overland flow or ponding resulting from capacity deficiency. The first criterion was based on the potential maximum flow assuming no conveyance limitations throughout the system. That maximum flow was considered relative to the capacity of specific segments of pipe. If the potential maximum was much greater (for this screening, 2 times greater) than the existing capacity, the section was considered very suitable for conveyance improvements. Additionally, model results were reviewed to identify which bottleneck segments

had surface flow or ponding at or near the segment indicating that existing overland conveyance could be conveyed underground. Conveyance improvements are often the most immediate solution, but may also be the most expensive and least resilient. Conveyance improvements can result in capacity issues downstream and do not provide the water quality benefits that other strategies do.

STRATEGY ASSUMPTIONS

Key assumptions reflected in the Strategy Evaluation are summarized in Table 5. All should be reviewed and refined for use in strategy development in the other 19 watershed basins.

Table 5: Summary of Evaluation Assumptions

Green Infrastructure	
Assumption	Notes
Impervious areas are from city plan metric data.	Input data for modeling, provided by city
Hydrologic soil group type A and B soils are considered most suitable for improving infiltration.	From NRCS national soil survey data
1" of rainfall can be achieved through green infrastructure implemented in an area with favorable soil	Volume reductions observed in HDR projects in New York.
Local Detention	
Assumption	Notes
Areas with Parks and City-owned land (excluding golf courses and cemeteries) greater than 1% of the entire basin are potentially available for local distributed storage.	From City's GIS database, potential to store water on City-owned property
Private parcels 3 acres or larger with greater than 50 percent impervious are potentially available for local distributed storage.	Potential to convert parking area or other large area to detention
Local distributed storage can provide volume calculated assuming an average 4' storage depth over 25% of total area.	Based on reasonable approximation of land that could be converted to detention
Regional Detention	
Assumption	Notes
Vacant parcels were identified manually	From aerial imagery dated June 2014 and the City's GIS database.
Regional storage volume reduction from was approximated by assuming 5' storage over the identified vacant land in a basin.	Based on reasonable approximation of land that could be converted to storage
Conveyance Improvements	
Assumption	Notes
Potential peak flow is calculated by assuming all runoff from upstream is captured and conveyed in the pipe network to the point of interest.	Estimate of maximum potential flow considering minimal storage
The potential peak capacity divided by existing pipe capacity ratio is an indicator of need for conveyance improvements.	Low difference between potential peak and capacity may lead to a bottleneck but not cause damages

STRATEGY EVALUATION FOR THE KENWOOD BASIN

The 20 project areas were screened separately for suitability based on the above criteria. The preliminary screening matrix is shown in Table 6. Following screening, strategies were given a "1" or "2" if based on the screening they would potentially be suitable and effective in mitigating

stormwater management issues in that project area or a downstream area. A “1” signifies that this strategy could be the primary mitigation strategy in the project area. A “2” signifies that this strategy could effectively reduce storm sewer surcharging but is not likely to completely mitigate the modeled deficiency. These classifications are shown in Table 6.

Soil data in the NRCS national soil database (see Attachment C) indicates the soils in the Kenwood basin, and across much of Cedar Rapids, are mostly type C and D. This limits the amount of infiltration / runoff reduction that can be achieved by incorporating GI retrofits throughout the basin. GI could still be incorporated in portions of the basin with type C and D soils with some reduction of runoff and water quality benefits. More than likely, over excavation and imported soils would need to be incorporated into GI in these areas.

Some project areas did have significant percentages of more permeable soils. GI could be leveraged in these areas to achieve the most significant improvements to runoff infiltration and runoff reduction. As indicated in Table 7, the screening criteria identified only three project areas (2, 3, and 20) where GI could be a secondary strategy. No project areas were identified where GI could be a primary strategy.

Based on this screening, local distributed storage would be beneficial in many project areas. However, there appears to be a lack of sufficient land available for this use (again, based on the screening criteria) due to the highly developed nature of the Kenwood basin. The availability of other land through buyouts for distributed storage could be evaluated in continuing to put together the overall strategy for Kenwood. However, as indicated in Table 6, the screening criteria identified only one project area (15) where distributed storage could be a primary strategy and six additional project areas (1, 6, 7, 9, 14, and 19) where it could be a secondary strategy.

Based on the screening criteria, no sites were identified in the Kenwood basin to incorporate regional detention. Again, the availability of other land through buy-outs for regional storage, particularly in flooded areas, could be evaluated in continuing to put together the overall strategy for Kenwood.

Based on this screening, nearly all project areas were identified as having a potential peak flow greater than 2X the existing pipe capacity. This likely drives the need for additional conveyance capacity because of the magnitude of the peak flow reduction otherwise necessary. As indicated in Table 7, the screening criteria identified that conveyance improvements could be the primary strategy in all but two of the project areas (2 and 13), with it being the primary strategy in eight project areas and a secondary strategy in ten.

Table 6: Stormwater Mitigation Strategy Suitability Screening Matrix

Project Area Catchment ID	Area Description	Green Infrastructure			Local Detention				Regional Detention			Conveyance Improvements		
		>30% Impervious	>40% Type A or B soils	1" Surcharge Volume/ DA	Parks or Municipal Land (>1%)	Private Parcels > 3 ac and >50% imp	Downstream Bottleneck	1' Surcharge Volume/Storage Area	Large Parcel(s)	Downstream Bottleneck	5' Surcharge Volume/ Parcel Area	Potential Peak/Capacity >2	Overland Conveyance	Section Bottleneck
Proj-1	14th St. NE & D Ave. NE			●		●		●				●		●
Proj-2	15th St. NE & D Ave. NE	●	●											●
Proj-3	15th St. SE & Washington Ave. SE	●	●				●			●		●	●	●
Proj-4	16th St. NE & C Ave. NE	●		●									●	●
Proj-5	16th St. SE & 3rd Ave. SE			●			●			●		●	●	●
Proj-6	16th St. SE & Washington Ave. SE	●		●	●		●			●		●		●
Proj-7	18th St. SE & Grande Ave. SE	●		●	●		●			●		●		●
Proj-8	20th St. NE & K Ave. NE					●			●		●	●	●	●
Proj-9	20th St. SE & Grande Ave. SE				●		●			●		●		●
Proj-10	21st St. SE & Washington Ave. SE			●			●			●		●		●
Proj-11	24th St. NE & F Ave. NE from NW			●								●	●	●
Proj-12	24th St. NE & F Ave. NE from SE	●				●						●	●	●
Proj-13	24th St. NE and F Ave. NE from NE			●										●
Proj-14	29th St. NE West of Eastern Ave. NE					●	●			●		●	●	●
Proj-15	33rd St. NE & Eastern Ave. NE			●		●	●	●		●		●	●	●
Proj-16	33rd St. NE & Mound Farm Dr. NE						●			●		●		●
Proj-17	36th St. NE & H Ave. NE			●			●			●		●		●
Proj-18	39th St. NE & Lennox Ave. NE			●			●			●		●	●	●
Proj-19	Forest Dr. SE & Blake Blvd. SE			●	●		●			●		●		●
Proj-20	Park Ct. SE & 3rd Ave. SE	●	●				●			●		●		●

Table 7: Mitigation Strategy Classifications

Priority Bottleneck Areas		Improvement Strategy Classification			
Project Area Catchment ID	Area Description	Green Infrastructure	Local Detention	Regional Detention	Conveyance Improvements
Proj-1	14th St. NE & D Ave. NE		2		2
Proj-2	15th St. NE & D Ave. NE	2			
Proj-3	15th St. SE & Washington Ave. SE	2			1
Proj-4	16th St. NE & C Ave. NE				2
Proj-5	16th St. SE & 3rd Ave. SE				1
Proj-6	16th St. SE & Washington Ave. SE		2		2
Proj-7	18th St. SE & Grande Ave. SE		2		2
Proj-8	20th St. NE & K Ave. NE				1
Proj-9	20th St. SE & Grande Ave. SE		2		2
Proj-10	21st St. SE & Washington Ave. SE				2
Proj-11	24th St. NE & F Ave. NE from NW				1
Proj-12	24th St. NE & F Ave. NE from SE				1
Proj-13	24th St. NE and F Ave. NE from NE				
Proj-14	29th St. NE West of Eastern Ave. NE		2		1
Proj-15	33rd St. NE & Eastern Ave. NE		1		1
Proj-16	33rd St. NE & Mound Farm Dr. NE				2
Proj-17	36th St. NE & H Ave. NE				2
Proj-18	39th St. NE & Lennox Ave. NE				1
Proj-19	Forest Dr. SE & Blake Blvd. SE		2		2
Proj-20	Park Ct. SE & 3rd Ave. SE	2			2

VOLUMETRIC ACCOUNTING EVALUATION

A volumetric accounting evaluation was performed to estimate how incorporating stormwater management practices in the basins identified in the suitability evaluation would affect total system surcharging; more particularly, whether the identified GI, local distributed storage, and regional storage opportunities could eliminate the need for conveyance improvements. Volumetric reductions were estimated based on the same assumptions used in the suitability screening (1 inch/acre for GI, 1 foot/acre of available distributed storage area). The volumetric accounting demonstrates that runoff can be reduced significantly but not all surcharging can be mitigated without conveyance improvements as shown in Table 8. A combination of GI, local distributed storage, and conveyance improvements will need to be implemented to mitigate stormwater management deficiencies in the Kenwood basin.

Table 8: Volumetric Accounting Evaluation

Project Area Catchment ID	Area Description	Local Volume Surcharge	Green Infrastructure Volume Reduction	Local Detention Reduction	Remaining Local Surcharge	Cumulative Surcharge	Regional Detention Volume Reduction	Remaining Volume Surcharge	Original Volume Surcharge	Volume Surcharge Reduction
		acre-foot	acre-foot	acre-foot	acre-foot	acre-foot	acre-foot	acre-foot	acre-foot	Percent
Proj-1	14th St. NE & D Ave. NE	3.5	0.0	0.0	3.5	5.9	0.0	5.9	11.8	49.6%
Proj-2	15th St. NE & D Ave. NE	15.2	7.2	0.0	8.0	59.9	0.0	59.9	83.2	28.0%
Proj-3	15th St. SE & Washington Ave. SE	8.2	5.8	0.0	2.4	2.4	0.0	2.4	8.2	70.9%
Proj-4	16th St. NE & C Ave. NE	2.0	0.0	0.0	2.0	2.0	0.0	2.0	2.0	0.0%
Proj-5	16th St. SE & 3rd Ave. SE	5.7	0.0	0.0	5.7	5.7	0.0	5.7	5.7	0.0%
Proj-6	16th St. SE & Washington Ave. SE	10.9	0.0	1.6	9.3	9.3	0.0	9.3	10.9	14.8%
Proj-7	18th St. SE & Grande Ave. SE	4.8	0.0	1.0	3.8	3.8	0.0	3.8	4.8	21.1%
Proj-8	20th St. NE & K Ave. NE	16.6	0.0	0.0	16.6	16.6	0.0	16.6	16.6	0.0%
Proj-9	20th St. SE & Grande Ave. SE	8.1	0.0	1.4	6.7	21.4	0.0	21.4	26.5	19.3%
Proj-10	21st St. SE & Washington Ave. SE	13.2	0.0	0.0	13.2	13.2	0.0	13.2	13.2	0.0%
Proj-11	24th St. NE & F Ave. NE from NW	0.5	0.0	0.0	0.5	38.0	0.0	38.0	67.0	43.2%
Proj-12	24th St. NE & F Ave. NE from SE	11.7	0.0	0.0	11.7	11.7	0.0	11.7	11.7	0.0%
Proj-13	24th St. NE and F Ave. NE from NE	4.7	0.0	0.0	4.7	4.7	0.0	4.7	4.7	0.0%
Proj-14	29th St. NE West of Eastern Ave. NE	25.0	0.0	5.6	19.4	37.5	0.0	37.5	66.4	43.6%
Proj-15	33rd St. NE & Eastern Ave. NE	21.1	0.0	29.7	0.0	9.1	0.0	9.1	32.4	72.0%
Proj-16	33rd St. NE & Mound Farm Dr. NE	9.0	0.0	0.0	9.0	9.0	0.0	9.0	9.0	0.0%
Proj-17	36th St. NE & H Ave. NE	2.2	0.0	0.0	2.2	2.2	0.0	2.2	2.2	0.0%
Proj-18	39th St. NE & Lennox Ave. NE	9.1	0.0	0.0	9.1	9.1	0.0	9.1	9.1	0.0%
Proj-19	Forest Dr. SE & Blake Blvd. SE	5.2	0.0	3.7	1.4	1.4	0.0	1.4	5.2	72.0%
Proj-20	Park Ct. SE & 3rd Ave. SE	18.2	7.5	0.9	9.8	49.9	0.0	49.9	66.0	24.4%
	Total	194.9	20.6	44.0	139.0			139.0	194.9	28.7%

A preliminary order-of-magnitude estimate of the cost to address the storm sewer conveyance deficiencies identified in the Kenwood basin-scale model results (12" storm sewers and larger) was developed. For simplicity, this estimate was based on simply paralleling all bottlenecked pipes with an in-kind pipe section. The cost was estimated based on a planning-level cost approximation of $5/in diameter with an additional $20 per linear foot to account for structures and inlets. The estimated cost for conveyance improvements in the pipe segments alone is roughly $12,500,000, roughly 3 times the $4,300,000 to parallel macro-scale model bottlenecks in larger pipes (48" storm sewers and above) with in-kind pipe sections . The $12,500,000 estimate does not account for any conveyance improvements in pipes smaller than 12", which were not modeled, or any storage/detention, culvert upsizing or repair, sewer extension, of implementation of low-impact retrofit.

Planning level estimates for implementing GI and local distributed storage were also developed, based on the potential opportunities from the suitability screening. For simplicity, these costs were based on published estimates for broad urban stormwater mitigation strategies, adjusted to 2016 construction costs. GI costs were approximated at $115,000/acre, and were implemented to reduce impervious areas by 15 percent where deemed suitable. Local distributed storage costs were approximated as $105,000 per acre-foot of storage. Based on the areas identified in the suitability screening, GI would cost approximately $2,800,000 and local distributed storage would cost approximately $4,600,000 if implemented to the full extent identified. As was demonstrated in the volumetric accounting evaluation, these measures could reduce surcharge runoff in the Kenwood watershed by approximately 25 to 30 percent.

A breakdown of the overall order of magnitude estimated cost for the Kenwood basin is summarized in Table 3. A portion, but not all, of these costs are reflected in the current FY 2017 CIP.

Table 3: Kenwood Basin Cost Implications

Strategy	Order-of-Magnitude Cost
Conveyance Improvements	$ 12,500,000
Green Infrastructure	$ 2,800,000
Local Distributed Storage	$ 4,600,000
Kenwood Total	**$ 19,900,000**

City-wide Cost Implications

Based on basin-scale model results, planning-level cost estimates for implementing conveyance improvements, distributed storage, and GI in the Kenwood basin total $19.9 million dollars. This is approximately 4.6 times as much as the estimated $4.3 million for major conveyance improvements for the Kenwood basin based on macro-scale model results.

Citywide, macro-scale model results indicated planning level costs to address major conveyance issues was estimated to be approximately $16.0 million. If basin-scale modeling produces a similar cost scaling Citywide to that observed in the Kenwood basin, implementation

of stormwater mitigation measures could total about $75 million, approximately 50 percent more than in the current CIP that includes just under $50 million of capital needs.

The planning-level cost estimate of $19.9 million for the Kenwood basin, based on basin-scale modeling, is nearly 90 percent greater than the existing CIP estimate for Kenwood. Assuming a similar cost scaling observed in the Kenwood basin applies Citywide, implementation of stormwater mitigation measures throughout the City could result in CIP needs approach $100 million, approximately 90 percent more than in the current CIP that includes just under $50 million of capital needs.

While very rough, these extrapolated costs, based on model results, indicate that overall capital needs are likely more extensive than currently identified based primarily on the June 2014 storm event. With further development over the next few years, the models will be able to more-fully inform and assist with development and prioritization of the CIP.

Future Considerations

GI and storage opportunities should be further investigated in the Kenwood basin. Preliminary evaluation indicates that several projects could be developed to reduce the additional conveyance capacity needs to address existing stormwater deficiencies in the Kenwood basin. Once investigated, a specific plan should be developed for the Kenwood basin. The specific projects in such a plan should be added into the FY 2018 to FY 2022 CIP and phased based on overall priority. Model results could be used to establish those priorities.

The two primary model driven metrics that could be used are frequency and extent of property damage and level of service provided by the existing stormwater system. The basin model could be used to evaluate a range of rainfall events (1-year to 100-year events for instance). The highest priority would be projects to address the most frequent and more severely impacted properties or structures. The next highest priority would be projects that address the most-frequently surcharged manhole and bottleneck pipe segments resulting in the most severe reductions in level of service.

Growth Impacts

EnvisionCR identifies targeted growth areas based on potential and serviceability. Those growth areas are summarized in TM 5.0 Policy and Other Considerations. The City's CIP as currently formulated does not include expenditures to address future growth related stormwater infrastructure deficiencies. This assumes that new development will not only consider the impacts to the specific areas being developed but will consider the potential impacts one to two or more miles away to handle any changes in existing flow volumes. Due diligence is required on the part of the City to assure that growth related stormwater infrastructure considers not just the associated growth, but future growth in the surrounding watershed as well.

Developers are required to prepare a Stormwater Management Plan for new development that considers the surrounding watershed, to provide stormwater infrastructure consistent with Metro Area Standards and the surrounding watershed, and to pay a $500 per acre stormwater management impact fee. To the extent that incremental costs are incurred for stormwater

infrastructure to accommodate development in the surrounding watershed, those incremental costs are eligible for reimbursement. As such, development pays for growth and growth related capital improvements are not included in the CIP.

On occasion, growth related stormwater infrastructure has not been adequate for the associated or future development. One such example is the stormwater infrastructure in the Viola Gibson area described below. A second such example is the stormwater infrastructure in the Stoney Point area where the current CIP includes the Rockhurst stormwater detention basin to remedy flooding associated with prior and future development flows. On such occasions, improvements to address growth related issues have to be included in the CIP.

Three growth corridors need additional review and guidance to prevent future stormwater conveyance and flooding issues. This additional review and guidance should be included in forthcoming annual updates to the Stormwater Master Plan.

- **Residential growth in the area beyond Viola Gibson Elementary School** which will impact the existing conveyance and detention system already experiencing basement flooding and retention basin capacity limitations and maintenance issues. The intent would be to identify a plan for expansion of the existing detention and conveyance system to address existing problems and provide for additional growth.
- **Residential and commercial growth areas in the Morgan Creek watershed** associated with construction of Highway 100. This growth will result in interactions with a creek that has not been extensively studied. The intent is to avoid a repeat of flooding problems in the Sun Valley SE along Indian Creek.
- **Major employer and large parcel growth in areas south of Highway 30**, including the "Super Park" area near the airport, which will affect a number of moderate to small sized streams and eventually extend over the ridgeline into the Iowa River basin.

Condition Related Needs

Stormwater conveyance infrastructure has a generally accepted service life for planning purposes of 80 to 100 years. The associated structures have a generally accepted service life for planning purposes of 40 to 50 years. However, depending on any number of factors, the actual service life varies. As stormwater infrastructure approaches its service life capital investment for renewal (rehabilitation and/or replacement) is required.

As the existing stormwater system continues to age, condition related needs will be increasingly significant. The current CIP is driven almost exclusively by flooding related needs, but does include $250,000 annually for repair and rehabilitation. As the City continues to refine and implement its Asset Management Program described in TM 2.0 Asset Management, condition related needs can be more accurately estimated and reflected in the CIP.

The potential exists that the $250,000 annual budget for repair and rehabilitation could underestimate, perhaps significantly the need. For example, the sanitary sewer system has budgeted an average of $1.6 million per year over the last 16 years for renewal related capital

improvements (lining, repairs, and replacement). The sanitary sewer system is contemplating a significant increase in this investment out of need moving forward.

FY 2018 CIP

Previously in this Technical Memorandum, Table 2 identified the following capital needs for FY 2018.

- Misc. Storm Water Projects
- Storm Water Master Plan Updates
- Stormwater BMP Cost Share
- Storm Sewer Inlet Modification
- FY Recurring Drain Tile Program
- Stormwater BMP's Streets
- Gibson Drive NE
- 18th Street SW at 29th Avenue SW Culvert Replacement
- Kenwood Sub-basin – 17 projects identified
- E Avenue Sub-basin – 9 projects identified
- 12th Street SW Near 32nd Avenue

As budgeting for FY 2018 through FY 2022 begins again in the fall, the FY 2017 CIP Technical Memorandum in Attachment A and the 304 Storm Sewer Capital Improvements Revised in Attachment B should be updated in light of the following.

- The status of ongoing stormwater capital improvements
- Potentially increased funding from recent changes to the Stormwater Utility Fee.
- Basin modeling priorities identified herein
- Growth corridor planning needs identified herein
- Basin modeling and asset management program identified needs
- The potential need to include a water quality component in the Kenwood basin model.
- The scope for the next phase of master planning

Attachment A – FY 2017 CIP Development TM

Technical Memorandum

Date:	Wednesday, March 09, 2016
Project:	Storm Water Master Plan Update
To:	City of Cedar Rapids
From:	William Bogert/Anderson Bogert, Terry Tiedemann/Anderson Bogert
Subject:	FY 2017 CIP Development

This Technical Memorandum (TM) presents the process of evaluating, prioritizing and scheduling storm water projects for the City of Cedar Rapids Iowa FY 2017 CIP.

The intent is to develop a project evaluation and ranking system that targets limited resources to meet significant storm water needs. The City of Cedar Rapids has identified storm water CIP projects totaling approximately $48 million dollars. With limited resources the City's goal is to target limited financial resources on projects that will provide the greater system performance benefit to residents in an objective, systematic, and open manner.

The process utilized for project selection uses two sets of criteria. The first set of criteria is to determine the project's priority. The second set of criteria evaluates the project's readiness by accounting for factors such as: land acquisition, previous City commitments, and funding sources. This two scale approach will ensure that critical issues within a system are being addressed while allowing the City flexibility to allocate funds to specific projects as warranted by readiness factors.

It is organized as follows.

- Objective
- Summary
- Background Information
- Analysis
- Recommendations

Objective

The objective of Technical Memorandum #1 is to develop a prioritization ranking approach to be utilized to develop a list of priority storm water projects for the FY 2017 CIP. While the main goal of this TM was to create a list of FY 2017 priority projects; the systematic and defendable approach developed to create these priorities is of equal importance. This approach provides the foundation for developing a living CIP Prioritizing and Planning Document. The CIP Prioritizing and Planning Document created is a single file that allows the user to evaluate, prioritize and schedule projects according to a combination of criteria and readiness factors.

The purpose of evaluating each project using the same set of criteria is to provide an objective analyses without regard to the source or frequency of the complaint, thus reducing the potential of bias between. As an additional step towards developing an unbiased and defendable

prioritization ranking approach; an internal quality control (QC) program should be developed. The main objectives of this QC program are to verify project scoring has been consistent across all projects and scores have been properly recorded. This could also be accomplished by having multiple staff members evaluate projects, compare assigned scores, and reach a consensus regarding scores. Developing and utilizing a standardized step-by-step project review involving QC will not only provide reliable and repeatable scores but can also assist staff when responding to questions related to specific project scores.

It is expected that this document will be reviewed and updated as often as new storm water projects are added to the CIP list or as project costs are updated. Revising and updating project scheduling is expected to occur annually as projects are selected for the upcoming fiscal year.

Summary

Technical Memorandum 1 can be summarized as follows.

Background Information includes a brief discussion regarding information assembled by City staff and furnished to the Consultant for review and evaluation. This information included a prioritization ranking spreadsheet and a CIP Summary Spreadsheet listing identified projects.

The Analysis includes the following topics:

- Evaluation of the Prioritization Ranking Criteria,
- Project Prioritization Rankings Based on Revised Criteria,
- Capital Improvement Project Summary Spreadsheet,
- FY CIP Project Selection,
- Proposed 6-Year Storm Water CIP Program, and
- FY CIP Funding.

Recommendations provide a brief discussion regarding the need for increased funding to meet the significant storm water needs, and discusses the four projects selected to be included within the FY 2017 Storm Water CIP Program.

Background Information

Through the years the City of Cedar Rapids has sustained considerable damages from river flooding and highly intense precipitation events, most notably the June 2014 flash-flood event. While events like these are infrequent the affected residents of Cedar Rapids have grown to expect the City to provide protection against all storm water related issues regardless of storm frequency. It is not the intent of this TM to address public education with respect to storm frequency and design standards but rather acknowledge the public's need for communication and information as it relates to evaluating, prioritizing and scheduling projects.

As a result of the 2008 Cedar River flooding and June 2014 flash-flooding event, considerable attention was directed towards addressing needs of the City's storm water system. Staff prepared a list of identified storm water projects, evaluated these projects using a prioritization ranking system, and then ranked them according to project severity. This information was

provided to HDR Engineering and Anderson Bogert, so that they could provide input on criteria and prioritization during the development of a FY 2017 Storm Water CIP.

Initial Prioritizing Ranking

In an effort to develop a systematic approach of prioritizing City storm water projects, City staff performed an on-line investigation of existing storm water project prioritizing methods utilized by other communities throughout the United States. From this research, staff selected a total of nine criteria to evaluate projects. During the evaluation process, staff utilized all nine criteria and provided scores for each of the criteria based on a defined level of severity. Criteria scores were weighted and tallied into a project prioritization ranking score. The prioritization ranking scores for all projects were sorted from highest (most severe) to lowest (least severe). The goal of developing a ranking system was to create a defendable process to evaluate and score (on a basis of 0 to 100) each of the City's storm water projects using a consistent set of pre-determined criteria.

Initially staff selected nine criteria (and weighting factors) to evaluate and rank projects; the initial nine criteria were:

- Health and Safety(6),
- Cost–Benefit (Cost of Potential Damage / Cost of Project)(4),
- Current Design Capacity(6),
- Asset Functionality(3),
- Water Quality(2),
- Associated Considerations (3),
- Sanitary Sewer Inflow Conveyance (1),
- Future Growth (1), and
- Easements (4).

Throughout the evaluation and refinement of the prioritizing ranking system, definitions and/or descriptions (and their weighting factors) were modified; the criteria listed above will be defined later within this TM.

In order to define the level of importance for each of the nine criteria, each was assigned a weighting factor by staff. The higher the weighting factor assigned to a criteria, the greater impact that criteria would have on determining the priority ranking score. The initial weighting factors are shown in parentheses behind the criteria listed above.

Identified Storm Water Projects

City staff provided a spreadsheet which contained a list of storm water projects which had been identified from various sources. These sources included: 1998 CDM Master Plan, earlier CIP programs, previously prepared drainage studies, 2014 FEMA Site Inspections (June 2014 flash flood event), 2015 Storm Sewer/Drainage Investigations and resident complaints. Accompanying information provided for these projects varied greatly. Of these projects, 17 were identified as having a current funding source and are currently under various stages of design and/or construction.

The City staff met with the Consultant on several occasions to discuss the storm water projects identified and provided previously written storm water reports on approximately one-third of the projects. Additional information supplied by City staff included: brief description of storm water issue, proposed scopes of work, and estimated project costs.

Description of Storm Water Issues. Descriptions of the identified projects include: aging infrastructure, flooding of yards/homes, flooding resulting in property damage, inadequate overland flow paths, inadequate infrastructure, etc.

Scopes of Work. The identified storm water projects range from minor infrastructure replacements to modeling, design and construction of detention basins.

Estimated Project Costs. Estimated costs provided for the projects varied from several tens of thousands of dollars for minor infrastructure replacements, to several million dollars for detention basin and sub-basin rehabilitation projects.

Capital Improvement Project Summary

City staff prepared a CIP Summary spreadsheet and provided it to the Consultant for independent review and analysis. This summary spreadsheet listed the projects, their issues as well as estimated construction costs. Staff reviewed each project according to the nine initial ranking criteria and prioritization ranking scores were calculated. After City staff prepared the list they submitted it to HDR and Anderson Bogert for independent review. Other than several recent FEMA related projects, which were the result of the 2014 flash flood event, the majority of the top twenty projects identified through the prioritizing ranking system were chronic long term problems.

Analysis

During the evaluation of the City's Prioritization Ranking system, it became apparent there were two main factors that affected fiscal year CIP selection: (1) project prioritization and (2) project readiness. For the purposes of this TM, project prioritization is the ranking of project according to a score derived from a standardized set of criteria and weighting factors. Project readiness affects scheduling. Readiness factors include: easement acquisition, land acquisition, funding sources, previously completed basin design studies, utility relocations and joint construction with other City programs. These factors are related to readiness as they can affect the timing of a project without affecting the prioritization.

As a result, the decision was made to prioritize storm water projects based upon a standardized set of criteria. Readiness issues would be used during FY CIP development, which would allow the City flexibility to allocate funds to specific projects as scheduling dictates.

Evaluation of Prioritization Ranking Criteria

During the evaluation of the initial nine storm water prioritization criteria provided by City staff, HDR Engineering and Anderson Bogert met on several occasions (independent of City staff) to determine if the proposed criteria were sufficient to captured a project's severity and impact on the community. The committee also reviewed and set weighting factors and scores for each

criteria, giving greater weighting factors to the criteria the committee felt were more significant. For consistency, each criteria was set up with a minimum score of zero points and a maximum score of two points. The higher the number of points issued for a given criteria indicates a greater impact in regards to that criteria. The revised Prioritization Ranking Form is provided as Attachment A.

Review and discussion of the nine initial prioritization ranking criteria is presented below.

Health and Safety. A primary goal of the City is to protect its residents from flooding and other hazards during rainfall events less severe than the current design standards. This criteria is concerned with protecting the citizen's health and safety during and after severe rainfall events. There was considerable discussion regarding whether this criteria should consider the impacts to all private property (including garages, warehouses and businesses) or whether to focus on occupied structures and ingress/egress to those structures by emergency service vehicles. The committee decided that protecting unoccupied structures should not be a factor when determining severity under this criteria. Businesses and property owners have the ability to purchase flood insurance to cover damages resulting from severe storm events. However, the committee did decide that protection of occupied structures/areas and the ability for residents and emergency services to utilize public streets to access these locations was vital.

To achieve a highest point score for this criteria, projects with impacts to occupied structures/area or street flooding would receive 2 points. Projects where overland flow is a concern but contained within pre-established flow paths would receive 1 point, and projects would receive zero points where minor issues such as standing water, although possibly presenting a mosquito issue, mainly affected mowing opportunities. The committee's input to assist with Health and Safety scoring is as follows:

- Higher health concern if water enters occupied structure, flooding of street is risk to vehicles &/or limits access to emergency services, flooding of parks & sidewalks is risk to pedestrians.

This criteria was assigned a weighting factor of 6.

Cost Benefit. The cost benefit criteria is a simple quantitative approach to determine if a project is an economically sound investment. Under this criteria the cost of a project includes but is not limited to: construction costs, engineering costs, acquisition costs, etc. The benefit is defined as the cost of potential damage (private and public) per occurrence for an event meeting the City's current design standard. The goal of this criteria is to provide a higher priority ranking for those projects which cause greater damage at the design standard event. The significance of the design standard event is to focus the City's resources on upgrading inadequate infrastructure to meet the current design standards. The costs of upgrading the entire system (the City's design storm) to meet the demands of infrequent events such as a 500-year storm or the 2014 flash flood event are not economically feasible.

City staff provided a Cost Benefit Table which was based upon a three point system. This table was modified to a two point system making it consistent with the other criteria, which are also based upon a two-point system.

The points under this criteria are awarded based upon the following cost benefit table:

Cost of Project	Cost of Potential Damage (Private and Public) per Occurrence of an Event Meeting the Design Standard		
	$0 to $300,000	$300,000 to $1,000,000	> $1,000,000
$0 to $300,000	1	2	2
$300,000 to $1,000,000	0	1	2
> $1,000,000	0	0	1

The committee's input to assist with Cost Benefit scoring is as follows:

- Extent of project(s), connectivity of different projects, etc.

This criteria was assigned a weighting factor of 4.

Current Capacity. The purpose of these criteria is to identify projects having issues during rainfall events less severe than the current design standard. Issues during less severe events indicate the capacity of the existing infrastructure does not meet current design standards. The purpose of this criteria is to provide a higher priority ranking score for projects affected by lesser storm events. To receive two points the existing infrastructure capacity must be significantly below the current design standard (2 or more design intervals). One point will be assigned for projects one design interval below current design standards, and infrastructure with capacity at or above the current design standard will be given a score of zero since it meets current design standards.

The committee's input to assist with Current Capacity scoring is as follows:

- Recurrence interval/level-of-service provided to prioritize projects to address problems that occur for rain events less than design standards. Applies to sewers, inlets, and street conveyance. City should be responsible for meeting design standards.

This criteria was assigned a weighting factor of 6.

Asset Functionality. Asset functionality utilizes the City's current standardized defect grading system, *Pipeline Assessment and Certification Program (PACP*). PACP is the North American Standard for pipeline defect identification and assessment, providing standardized and consistency to the methods in which pipeline conditions are identified, evaluated and managed. The PACP grading system includes both structural defects and maintenance defects and assigns a level or grade to each defect. This standardized grading allows the City to evaluate and compare existing infrastructure using an industry recognized system.

Projects are assigned points according to their PACP Grade. A project with a PACP Grade 5, which represents a permanent reduction of design capacity (collapsed or collapse imminent) or a problem/defect recurring annually or more frequently is assigned two points. A project with a PACP Grade 4, which represents a reduction of design capacity (collapse likely in foreseeable future) or problem/defect recurring every 5 or more years, is assigned one point. Projects with a PACP Grade 3 or lower (collapse unlikely in near future) or no history of recurring problems is assigned a score of zero.

The committee's input to assist with Asset Functionality scoring is as follows:

- Applicable to sewers and detention basins. Condition of asset impacting functionality, level of maintenance required to maintain capacity. Service life of asset relative to age of asset? Is operation/maintenance of system improved with the project?

This criteria was assigned a weighting factor of 4 (increased from 3).

Water Quality & Environmental. The purpose of this criteria is to provide a means of identifying projects discharging into regulatory restricted waters. Several water bodies within the City of Cedar Rapids are currently monitored/regulated for specific sediment, temperature, nutrient or organic loading by the IDNR or EPA; these include McLeod Run, Indian Creek and Prairie Creek.

The objective of the Clean Water Act, and subsequent Amendments, is to restore and maintain chemical, physical, and biological integrity of the Nation's waters. The goal is to establish water quality that provides protection of fish and wildlife, as well as providing safe recreational use. In the future, it is possible that additional monitoring requirements may be imposed, such as limits on nitrogen and phosphorous.

The committee's input to assist with Water Quality & Environmental scoring is as follows:

- Sediment/nutrient/organic loading. Waters listed in 303d &/or impacting McLeod Run (temp & sediment)? Indian Creek & Prairie Creek impaired for bacteria. Nitrates are pollutants of concern. Potential for regulatory issues (DNR)?

This criteria was assigned a weighting factor of 2; however, future regulatory requirements may require this factor to be modified.

Associated / Other Considerations. The purpose of this criteria is to identify and capture other considerations (driving forces) that influence a project's prioritization. These driving forces may be the result of previous discussion with property owners or developers where commitments or timelines were implicitly or explicitly implied by staff. The definition provided below lists additional considerations that affect project prioritization.

The committee's input to assist with Associated / Other Considerations scoring is as follows:

- Discussions with citizens on project needs (w/ or w/o timeline commitments)...want to acknowledge past discussions with residents and no resolution or activity on a project. Are there other compelling reasons that would make a project a higher priority? Such as: prior commitments, political pressures, potential to partner with developers, regulatory mandates, multi-use features, quality of life, visual quality of environment, enhanced sustainability, low-impact development, consequence(s) of delay, etc.

This criteria was assigned a weighting factor of 3.

Sanitary Sewer Inflow Conveyance. There are areas within the City of Cedar Rapids with sanitary sewer inflow and infiltration issues. In the future it is foreseeable City policy may require the disconnection of sanitary inflow sources such as: sump pumps, footing drains, down spouts, etc. from the existing sanitary sewer collection system. Allowing residents to discharge these sources directly onto the ground will likely create neighbor disputes, slip and fall hazards, and/or groundwater flow paths leading to increased pumping.

This criteria pertains to additional storm sewer capacity required to not only convey the design standard event, but also the additional flow from disconnected sanitary sewer inflow sources.

In order to receive the maximum number of points for this criteria, neighborhoods with known inflow issues receive a point score of 2. Projects without known sanitary inflow issues receive a score of zero.

The committee's input to assist with Sanitary Sewer Inflow Conveyance scoring is as follows:

- Is additional storm capacity provided in areas where I&I reduction will require more capacity?

This criteria was assigned a weighting factor of 1. As the City of Cedar Rapids enacts sanitary sewer inflow policy, this weighting criteria may increase.

Future Growth & Sustainability. The purpose of this criteria is to identify future growth areas using existing City planning documents and develop an overall plan for storm water control and conveyance. This overall plan may consist of larger City owned and maintained storm water detention basins serving multiple developments to revising and enforcing existing development standards.

Projects located in future growth areas as identified by EnvisionCR or compatible with sustainable policies within iGreenCR receive a score of 2 points.

The committee's input to assist with Future Growth & Sustainability scoring is as follows:

- Growth or redevelopment area identified by EnvisionCR and/or compatible with City's sustainability initiatives/policies (iGreenCR). Progressive approach to get ahead of development - revisit & enforce development standards.

This criteria was assigned a weighting factor of 3 (increased from 1).

Easements. Initially, easements were listed as a priority ranking criteria. Due to the timeliness and possible project delays, easement acquisition lowered a project's priority ranking score by subtracting points if easements were required to construct the project. The lowering of the priority ranking score on the basis of a projects location to privately held property appeared inconsistent with prioritizing projects based upon severity and need. As a result, the issue of easements was removed as a prioritizing ranking criteria.

Easements are currently viewed as a state of project readiness and play a key factor in determining FY CIP development and scheduling.

Progressive Damage. Progressive damage was considered as an additional criterion to incorporate urgency for storm water issues that become worse with each subsequent rain event and could ultimately lead to higher repair costs, if not addressed in a timely fashion. After extensive discussion, it was decided not to include progressive damage as a separate criterion. This decision was based upon the existence of other criteria such as, Asset Functionality and Associated / Other Considerations, which could adequately capture the progressive damage criterion.

Project Prioritization Rankings Based on Revised Criteria

The initial list of storm water projects identified by staff was re-prioritized based upon the revised set of ranking criteria and is presented in Attachment B.

The effect of re-prioritization based upon modifications to the ranking criteria was minimal. Six of the top ten projects prior to re-prioritization remained in the top ten following re-prioritization, and seventeen of the top twenty projects remained in the top twenty. Of the four projects newly added to the top ten prioritization, one project was newly added to the list following a resident complaint; the other three projects saw an increased priority ranking score as a result of increases to two weighting factors: Asset Functionality and Future Growth & Sustainability. The weighting factors for Asset Functionality were increased from three to four and Future Growth & Sustainability was increased from one to three.

As a result of the Future Growth & Sustainability significant increase in weighting factor (1 to 3), projects within identified future growth areas could see their raw priority ranking scores increase by four points and their normalized score (based on maximum 100) increase by approximately six points. It is important to note that by increasing the prioritizing ranking scores for future growth areas (and policy changes addressing development within these growth areas), the City may also incur significant savings related to storm water detention basin maintenance.

Capital Improvement Project Summary

The goal of creating a Capital Improvement Project Summary was to create a single working document to be utilized by staff to assess storm water projects from identification through CIP scheduling. Organizing and providing project information into a single document will provide staff the ability to identify, organize, and prioritize projects using the newly created Prioritization Ranking Criteria and to develop a 6-Year Storm Water CIP based upon specific project readiness issues, such as, easement or ROW acquisition requirements, basin modeling, or other City construction projects proposed in the same area.

The CIP Summary spreadsheet has been created to allow the user to manipulate and view data to identify project connectivity between projects. Information can be sorted and displayed using sorts and filters according to the column headings. A brief description of the column headings provided in the spreadsheet is provided below:

ID. Each project requires a unique identification number. This ID could be any combination of date, year, or consecutive numbering in which projects /complaints were brought to the attention of City staff. For consistency with previously written reports/evaluations, case numbers were used. This ID could be changed to a City CIP number, once one is determined.

Watershed. The watershed location for each project is listed. This allows the user to quickly determine the number and locations of identified projects within each watershed, as well as the connectivity between related projects.

Location. Street address or area for which the project is located.

Quadrant. Identification for which part of the City the project is located.

Issue. Brief description of the storm water problem, in order to provide the user a basic understanding of the complaint or issue. Specific project information is located in reports and evaluations.

Proposed Scope of Work. Brief description of the proposed construction scope of work.

City Comments. This column provides additional project information obtained during several meetings with City staff.

Project Category. One to three word description of the proposed project issue.

Zone A X. Outside funding sources such as the Hazard Mitigation Assistance (HMA) grant programs provides funds on an annual basis, so that measures can be taken to reduce or eliminate risk of flood damage to buildings insured under the National Flood Insurance Program (NFIP). This column identifies projects located within flood plains, which may be eligible for outside grant programs.

Est. Total Cost. Column provides the estimated total cost of a project.

Est. Design/ROW Acquisition Costs. Column provides an estimated cost for design and right-of-way acquisition costs. Unless specific information was provided for these costs they were assumed to be 15% of the estimated total cost. For larger multi-year projects, this amount was budgeted in the CIP a fiscal year prior to initiating construction activities.

Est. Construction Costs. Estimated to be 85% of the total project cost.

Available Funding. Lists available funding if a project has been previously funded. Thirteen of the projects have been identified as having available funding.

2014 Flash Flood Case. Following the June 2014 event, reports/evaluations were compiled on various projects; this column lists the Case number for the report/evaluation.

Evaluation. If a report/evaluation of the project has been previously completed, this column provides the source of that report/evaluation.

Prioritized Rank. Numerical rank of the project based upon the Prioritization Score. The project with the highest prioritization score is ranked #1.

Prioritization Score. Column lists the normalized prioritization score based upon the eight ranking criteria previously presented.

ROW Acquisition Required. This column identifies if land acquisition or easements are required for the project. This readiness factor provides information to the CIP scheduler regarding duration of design and delayed construction start to account for ROW/easement acquisition.

Other Factors. The purpose of this column is to alert the CIP scheduler of other factors that affect scheduling or readiness of projects. Some of these factor are: if sub basin modeling is recommended, if progressive damage is occurring, prior City commitments related to project completion, if the design is complete, etc.

Other City Projects in Area. The purpose of this column is to identify other City projects scheduled with the vicinity of the storm water issue and piggyback the storm water project into the other scheduled City project. By knowing in advance of ongoing Utility or Paving for Progress, projects any required sub basin modeling can be completed and the necessary improvements incorporated into the design of the 'Other Project'. This could include but is not limited to; inlet size and spacing, culvert location and spacing, property acquisition, etc.

2016 CIP. Proposed project funding identified for the FY 2016 CIP.

2017 CIP. Proposed project funding identified for the FY 2017 CIP.

2018 CIP. Proposed project funding identified for the FY 2018 CIP.

2019 CIP. Proposed project funding identified for the FY 2019 CIP.

2020 CIP. Proposed project funding identified for the FY 2020 CIP.

2021 CIP. Proposed project funding identified for the FY 2021 CIP.

Total CIP 2016-2021. Proposed total project funding over the 6-year CIP Plan.

Project Completed within 6-Year CIP Plan. Column identifies if the project is proposed to be completed within the 6-year CIP Plan.

Source. Identifies the source of the project complaint.

Study. Identifies studies that have been previously performed.

Action taken on Issue. Describes any construction or maintenance action that may have been taken on the project and affect it had on the project.

Project Name. Provides a specific name for the project; assigned by the City.

Funding Source. Provides funding source for the project.

Prioritization Ranking Criteria. As projects are identified and added to the CIP Summary spreadsheet the user can evaluate the project according to the prioritization criteria previously presented and the spreadsheet will calculate a prioritization score for that project. Sorting the projects by the Prioritization Score column will reorganize projects by their prioritization score and reassign the projects CIP ranking.

FY CIP Project Selection

The attached CIP Development Spreadsheet (Attachment B) presents a list of identified storm water projects for the City of Cedar Rapids Iowa. The projects on this list vary from relatively small culvert and inlet rehabilitations, to multi-year multi-phase design/construction projects requiring sub-basin modeling, land acquisition and policy modifications. The CIP Development Spreadsheet is also a tool that facilitates the allocation of resources based on project prioritization and readiness factors reflecting the community needs.

This spreadsheet is meant to be dynamic, and updates to this document are expected. Updates can represent changes in City growth areas, storm water needs, partnerships, funding strategies and changes in resources over time. Additional storm water projects can be added and prioritized into the existing project list at any time using the prioritization ranking system, which is built into this spreadsheet.

The projects on the CIP list have been organized according to their prioritization ranking score (project severity) from highest to lowest. As discussed previously, the proposed ranking system evaluated all projects against the same set of criteria, thus creating a defendable priority ranking of all known storm water projects. While priority ranking of projects represents the backbone for CIP project selection, other factors such as project readiness and engineering judgement play a significant role in determining the sequential order for which projects are selected for design and construction.

Engineering judgement plays a vital role regarding scheduling and funding specific projects or scheduling and funding sub-basin modeling. Due to the number of projects located within certain sub-basins and their interaction, it is recommended that sub-basin modeling be performed to minimize the design and construction needs within the sub-basin. Based upon the modeling and proposed improvements, several previously identified projects may be rectified by a single construction project. For example, the Kenwood and the E Avenue sub-basins have 17 and 9 identified projects, respectively. These two sub-basins account for eight of the ten projects ranked between 11 and 20.

Proposed 6-Year Storm Water CIP Program

After identifying and ranking projects the next step is to develop a timeframe for financing and constructing projects, based upon the prioritization and readiness issues as outlined within this TM. It is important to remember that although all projects have been ranked against each other, the actual selection cannot be based solely upon project rank; readiness factors and engineering judgement are equally important. A 6-year storm water CIP has been developed for FY 2016 through FY 2021 and is presented below. The plan includes the project, storm water issue, basis for FY selection, multi-year project identification, and projected budget for that fiscal year.

The proposed 6-year Storm Water CIP Program (FY 2016 thru 2021) projects and estimated costs are presented in the following tables.

FY 2016 Storm Water CIP

Project Name	Priority Ranking	Storm Water Issue	Basis for Selection	Multi-Year	Budget
Misc. Storm Water Projects	-	Unidentified repairs	Annual	-	$250,000
Storm Water Master Plan Updates	-	Modeling and Updates	Annual	-	$100,000
Rockhurst at 1st Avenue SW	1	Overland and residential flooding within the Stoney Point subdivision	Land for detention basin is currently for sale	2016-17	$271,000
Detention basin west of 11th Street NW and south of N Avenue	2	No suitable overland flow path from the detention basin near Harrison Elementary overtops. Outlet structure from basin does not meet design standards	Priority Ranking	2016-18	$270,000
27th Street SW Culvert Replacement	4	Failure of undersized culvert	Design and ROW acquisition complete.	2016-17	$560,000
18th Street SW Detention Basin	24	Regional detention basin required as part of development agreement	Prior Agreement between Developer and City	2016-17	$249,000
				TOTAL	**$1,700,000**

FY 2017 Storm Water CIP

Project Name	Priority Ranking	Storm Water Issue	Basis for Selection	Multi-Year	Budget
Misc. Storm Water Projects	-	Unidentified repairs	Annual	-	$250,000
Storm Water Master Plan Updates	-	Modeling and Updates	Annual	-	$100,000
Rockhurst at 1st Avenue SW	1	Overland and residential flooding within the Stoney Point subdivision	Land for detention basin is currently for sale	2016-17	$881,000
11th Street NW Detention Basin	2	Detention Basin Floods with no overland flow paths	Design, Survey and Sub-basin Modeling	2016-18	$418,000
18th Street SW Detention Basin	24	Regional detention basin required as part of development agreement	Prior Agreement between Developer and City	2016-17	$401,000
				TOTAL	**$2,050,000**

FY 2018 Storm Water CIP

Project Name	Priority Ranking	Storm Water Issue	Basis for Selection	Multi-Year	Budget
Misc. Storm Water Projects	-	Unidentified repairs	Annual	-	$250,000
Storm Water Master Plan Updates	-	Modeling and Updates	Annual	-	$100,000
11th Street NW Detention Basin	2	Detention Basin Floods with no overland flow paths	Design, Survey and Sub-basin Modeling	2016-2018	$812,000
Gibson Drive NE	5	Detention basins are undersized resulting in overtopping and flooding of yards.	Design, Survey and Sub-basin Modeling	2016-18	$400,000
18th Street SW at 29th Avenue SW Culvert Replacement	6	Existing culvert is aging and is undersized.	Priority Ranking	2018-19	$200,000
Ushers Ferry Creek North of 42nd Street Detention Basin	9	Residential development creating excessive storm water runoff.	Priority Ranking	2018-19	$100,000
Kenwood Sub-basin	11	Sub-basin has collection, conveyance, and detention issues causing local and area wide flooding	17 Projects Identified within Sub-basin - Begin Modeling and Design	2018-?	$238,000
				TOTAL	**$2,100,000**

FY 2019 Storm Water CIP					
Project Name	**Priority Ranking**	**Storm Water Issue**	**Basis for Selection**	**Multi-Year**	**Budget**
Misc. Storm Water Projects	-	Unidentified repairs	Annual	-	$250,000
Storm Water Master Plan Updates	-	Modeling and Updates	Annual	-	$100,000
18th Street SW at 29th Avenue SW Culvert Replacement	6	Existing culvert is aging and is undersized.	Priority Ranking	2018-19	$500,000
Ushers Ferry Creek North of 42nd Street Detention Basin	9	Residential development creating excessive storm water runoff.	Priority Ranking	2018-19	$400,000
Kenwood Sub-basin	11	Sub-basin has collection, conveyance, and detention issues causing local and area wide flooding	17 Projects Identified within Sub-basin	2018-?	$500,000
E Avenue Sub-basin	15	Sub-basin has collection, conveyance, and detention issues causing local and area wide flooding	9 Projects Identified within Sub-basin	2019-?	$400,000
				TOTAL	**$2,150,000**

FY 2020 Storm Water CIP					
Project Name	**Priority Ranking**	**Storm Water Issue**	**Basis for Selection**	**Multi-Year**	**Budget**
Misc. Storm Water Projects	-	Unidentified repairs	Annual	-	$250,000
Storm Water Master Plan Updates	-	Modeling and Updates	Annual	-	$100,000
Kenwood Sub-basin	11	Sub-basin has collection, conveyance, and detention issues causing local and area wide flooding	17 Projects Identified within Sub-basin	2018-?	$600,000
E Avenue Sub-basin	15	Sub-basin has collection, conveyance, and detention issues causing local and area wide flooding	9 Projects Identified within Sub-basin	2019-?	$500,000
12th Street SW near 32nd Avenue	25	No overland path results in flooding of business	Priority Ranking	2020-21	$235,000
35th Street NE at Collins Plant	29	Water from Elmcrest golf course overland flows across road into building.	Priority Ranking	2020-21	$300,000
6th Street SW 1200 Block	31	Conveyance capacity limited resulting in flooded neighborhood	Priority Ranking	2020-?	$225,000
				TOTAL	**$2,210,000**

FY 2021 Storm Water CIP					
Project Name	**Priority Ranking**	**Storm Water Issue**	**Basis for Selection**	**Multi-Year**	**Budget**
Misc. Storm Water Projects	-	Unidentified repairs	Annual	-	$250,000
Storm Water Master Plan Updates	-	Modeling and Updates	Annual	-	$100,000
Kenwood Sub-basin	11	Sub-basin has collection, conveyance, and detention issues causing local and area wide flooding	17 Projects Identified within Sub-basin	2018-?	$504,000
E Avenue Sub-basin	15	Sub-basin has collection, conveyance, and detention issues causing local and area wide flooding	9 Projects Identified within Sub-basin	2019-?	$500,000
12th Street SW near 32nd Avenue	25	No overland path results in flooding of business	Priority Ranking	2020-21	$406,000
35th Street NE at Collins Plant	29	Water from Elmcrest golf course overland flows across road into building.	Priority Ranking	2020-21	$300,000
6th Street SW 1200 Block	31	Conveyance capacity limited resulting in flooded neighborhood	Priority Ranking	2020-?	$200,000
				TOTAL	**$2,260,000**

FY CIP Funding

With total estimated project costs at $48.2 million dollars and a FY 2017 storm water CIP budget of $2.05 million (which includes a $350,000 transfer from 671 reserves), the City is targeting very limited resources at significant storm water needs. Based upon current storm water funding levels, it would take approximately 23 years to fund the projects identified on the CIP list. As the existing system continues to age and the City continues to expand, storm water needs will only continue to increase. In order to meet the existing fiscal needs (as well as future needs), a storm rate increase is prudent and necessary.

Attachment B presents FY 2016-2021 Storm Water CIP Program based upon current funding levels ($2.1 million with 3% annual increases). This 6-year CIP Program identifies 11 storm water projects completed and the Kenwood and E Avenue sub-basins receiving approximately $3.7 million in funding for survey, modeling, engineering designs and construction activities.

It is well known the newly developed storm water utility has significant needs. Many of these needs were identified in the 1998 Storm Water Master Plan and were not fully addressed due to minimal storm water funding. Several projects, which include drainage basin and overland flow path construction through developed areas of the community, will not only be expensive but could also be highly controversial.

In order to address the needs of the past twenty years, as well as future storm water issues associated with growth and aging infrastructure, a significant increase in funding is required. Current funding levels are inadequate to address the existing storm water needs. As aging infrastructure deteriorates and community growth creates downstream capacity issues, a significant increase in funding will be required.

Recommendations

The following two sections present recommendations for CIP storm water funding and describe the selected projects to be included within the FY 2017 storm water CIP.

FY 2017 CIP Funding

The proposed FY 2017 Storm Water CIP has been based upon a CIP budget of $2.1 million. With only a 5% rate increase the existing FY 2017 CIP budget will be supplemented with $350,000 from 671 reserves to achieve the $2.1 budgeted. Approval of both the proposed 5% utility rate increase and billing mechanism change would completely fund the FY 2017 CIP budget of $2.1 million (without using 671 reserves). Funds in excess of the $2.1 million would be transferred into 304 for FY 2018 CIP projects.

It is imperative to note that the City has significant storm water needs, many of which, although identified over the past 15-20, years remain due to the lack of funding. With storm water needs in excess of $48 million, City staff find themselves trying to fund significant needs with limited resources. The recently created storm water utility fee directed towards storm water issues was much needed; however, current fee schedules are far below those necessary to adequately fund a system requiring $48 million in required upgrades and repairs. Therefore, it is the recommendation of this TM to increase fees to levels capable of meaningful progress towards meeting the City's current and future storm water needs in a timely fashion.

FY 2017 CIP – Project Identification

According to prioritization and readiness issues, three projects were selected for the FY 2017 CIP program. These three projects have an estimated FY 2017 CIP budget of $1,700,000. The following paragraphs provide brief descriptions of the selected projects.

Rockhurst Drive SW at 1st Avenue SW. Overland flows and residential flooding occur as a result of severely undersized detention basin. The depth of the overland flow has been recorded at depths of 4 to 5 feet in some locations and has caused road closures on the following roads: Rockhurst Drive SW, 1st Avenue SW, Rock Ridge Road NW, and Stoney Creek Road NW. In order to alleviate overland flooding issues, a detention basin is recommended at the Southwest corner of 1st Avenue and Rockhurst Drive SW. This land is currently for sale.

This project was ranked #1 on the priority scale and has an estimated budget of $1,152,000. The 6-Year CIP Program has allocated $271,000 in FY 2016 and the remaining $881,000 in FY 2017. The Consultant recommends the City proceed with land acquisition, detention basin design in FY 2016 and construct the project in FY 2017. In order to recoup project dollars, the City may consider the creation of a regional detention basin watershed, which will provide storm

water management to developers for a percentage of the cost required for basin construction and annual fees to maintain the facility.

11th St NW (south of N Ave) Detention Basin. This project consists of frequent overtopping of an existing detention basin located west of 11th St NW and south on N Avenue NW. There is no suitable overland flow path from this basin and the outlet structure requires reconstruction. This project requires multi-year funding 2016-2018 and is ranked #2.

18th St SW Detention Basin. This project consists of the construction of a required regional detention basin as part of a prior development agreement between the City and a developer. This project while only ranked #24 was selected based upon a previous City commitment. The estimated budget for this project is $650,000. The City allocated $249,000 in FY 2016 and the remaining $401,000 in FY 2017

Attachment B – 304 Storm Sewer Capital Improvements Revised

304 FUND CAPITAL IMPROVEMENT PROJECT SUMMARY (Revised April 2016)

ID	Watershed	Location	Quadrant	Issue	Proposed Scope of Work	Est. Total Cost	Available Funding	Prioritized Rank	Prioritization Score	Other Factors	Currently Allocated (10/9/2015)	2016 CIP	2017 CIP	2018 CIP	2019 CIP	2020 CIP	2021 CIP	Total CIP 2016-2021	Project Complete within 5-Year CIP Plan
-	-	-	-	Annual Misc. Storm Water Projects	Repair and rehabilitation	-	-	0	100			$ 250,000	$ 200,000	$ 200,000	$ 200,000	$ 200,000	$ 200,000	$ 1,250,000	
-	-	-	-	Stormwater BMP Cost Share	City Cost Share for Private BMPs	-	-	0	100				$ 25,000	$ 25,000	$ 25,000	$ 25,000	$ 25,000	$ 125,000	
-	-	-	-	Storm Sewer Inlet Modification	Safety Guards on Stormwater Inlets	-	-	0	100				$ 50,000	$ 50,000	$ 50,000	$ 50,000	$ 50,000	$ 250,000	
-	-	-	-	FY Recurring Drain Tile Program	Drain Tile Improvements	-	-	0	100				$ 50,000	$ 50,000	$ 50,000	$ 50,000	$ 50,000	$ 250,000	
-	-	-	-	Stormwater BMP's Streets	Green Infrastructure Projects	-	-	0	100				$ 200,000	$ 100,000	$ 100,000	$ 100,000	$ 100,000	$ 600,000	
-	-	-	-	Annual Master Plan Updating	Modeling and updating	-	-	0	100	-		$ 100,000	$ 100,000	$ 100,000	$ 100,000	$ 100,000	$ 100,000	$ 600,000	
-	-	-	-	Hwy 100 Edgewood to Hwy 30		135,000		0	100	Land Acquisition Required Basin Modelling		$ -	$ 135,000					$ 135,000	YES
Case 18	Morgan Creek	Rockhurst Drive SW	SW	Overland and residential flooding within the Stoney Point subdivision	Construct an upstream detention basin	1,152,000	None	1	90	Land Acquisition Required Basin Modelling		$ 271,000	$ 880,000					$ 1,151,000	YES
Case 23	O Avenue	Detention basin west of 11th Street NW and south of N Avenue	NW	No suitable overland flow path from the detention basin near Harrison Elementary overtops. Outlet structure from basin does not meet design standards	Model drainage area to compare upstream basin vs overland path	1,500,000	None	2	79	Basin Modelling		$ 270,000	$ 300,000					$ 570,000	YES
-	Prairie Creek	Beverly Road SW	SW	Culvert failure	Replace failed culvert	216,785	2014 FEMA	3	79									$ -	YES
Case 12	Prairie Creek	27th Street SW north of 29th Avenue	SW	Failure of undersized culvert	Replaced 132-inch steel-plate culvert with triple 12'x7' RBC	776,000	FY2015	4	76	Completed Design (Shive-Hattery)	$ 216,000	$ 560,000						$ 560,000	YES
Case 171	Czech Village	21st Street SW	NW	Aging and undersized truck sewer causing ponding issues	Replace 84-inch brick storm sewer with 7'x5' box storm sewer	650,000	None	5	76	Funded with 304 Reserves		$ 650,000							YES
Case 101	Ushers Ferry	Gibson Drive NE	NE	Detention basins are undersized resulting in overtopping and flooding of yards.	Reconstruct detention basins.	500,000	FY2015	6	72		$ 100,000			$ 400,000				$ 400,000	YES
Case 102	Prairie Creek	18th Street SW at 29th Avenue	SW	Existing culvert is aging and is undersized.	Replace Existing Culvert.	700,000	None	7	71					$ 200,000	$ 500,000			$ 700,000	YES
Case 26	E Avenue	Auburn Drive SW north of 16th Avenue	SW	Flooding due to no overland flow path	Construct additional intakes and a stormwater channel to convey overland flow	260,000	FY2014	8	69									$ -	YES
Case 103	Czech Village	20th Avenue SW	SW	Road closed due to culvert failure	Replace Culvert with 5'x7' RBC	332,925	2014 FEMA	9	69									$ -	YES
Case 169	O Avenue	1521 Hidden Hollow Lane NW	NW	Existing 30" RCP Culvert has pipe seperation and severe erosion. Located in 30-ft easement between two homes.	Culvert failure with severe erosion between two houses within drainage easement. Existing 30" RCP has seperation at joints. Relay culvert, install outlet structure, Install additional culvert in lieu of overland flow path.	115,000	FY 2016	10	69	PROGRESSIVE DAMAGE (Small storms causing continued eriosion between two houses.)	$ 115,000							$ -	YES
Case 20	Kenwood	Forest and Grande SE	SE	Conveyance capacity limited resulting in flooded neighborhood		4,000,000	None	11	62	Basin Modelling				$ 400,000	$ 350,000	$ 800,000	$ 800,000	$ 2,350,000	NO
Case 20	Kenwood	Meadowbrook at Bever SE	SE	Flooding in yards	Model drainage area and construct upstream detention basin(s) to attenuate flow	0		12	62	Basin Modelling								$ -	NO
Case 20, Case 30	Kenwood	Park Court SE	SE	Flooding at Park Ct caused by overland flow		0		13	62	Basin Modelling								$ -	NO
Case 20, Case 16	Kenwood	Washington Avenue SE	SE	Flooding at Washington Avenue SE caused by overland flow		0		14	62	Basin Modelling								$ -	NO
Case 29	E Avenue	Johnson Avenue NW Hy-Vee and B Avenue NW	NW	Flooding due to undersized box culvert and inadequate overland flow path	Model drainage area and expand upstream detention	3,000,000	None	15	62	Basin Modelling				$ 400,000	$ 309,000	$ 800,000	$ 800,000	$ 2,309,000	NO
Case 105	E Avenue	Vinton Ditch at D Avenue	NW	Storm sewer separation causing structure instability of gabion wall.	Repair storm sewer.	100,000	None	16	62	Basin Modelling	$ 100,000							$ -	YES
Case 31	Indian Creek	Between Sunland Court SE and Cottage Grove Parkway	SE	No overland path	Extend storm sewer to reduce backyard flooding.	250,000	None	17	62	Residential Buy-out								$ -	YES
Case 27	E Avenue	31st Street SW between 2nd Avenue and 12th Avenue	SW	Excessive overland flow causing flooding on 2nd Avenue SW.	Construct upstream detention, complete localized grading, expand storm sewer	2,250,000	None	18	62	Basin Modelling								$ -	NO
Case 20	Kenwood	A Avenue and B Avenue NE	NE	Extensive property damage from flash flooding. Location is near the end of the Kenwood watershed.	Regrade for overland flow path or add upstream detention to reduce peak flows. Cost estimate if for overland flow path.	2,450,000	None	19	59	Basin Modelling								$ -	NO
Case 106	Cedar River	Penn Avenue NW at 1st Street NW	NW	Storm sewer is clogged. Requires new manhole to access pipe.	Install manhole with sluice gate. Remove debris from storm sewer. Construct headwall around storm sewer outlet	150,045	2014 FEMA	20	59									$ -	YES
Case 107	Prairie Creek	Lakeview Drive SW north of Beverly Road	SW	Overland flow resulted in erosion	Bank restoration	65,000	2014 FEMA	21	59									$ -	YES

304 FUND CAPITAL IMPROVEMENT PROJECT SUMMARY (Revised April 2016)

ID	Watershed	Location	Quadrant	Issue	Proposed Scope of Work	Est. Total Cost	Available Funding	Prioritized Rank	Prioritization Score	Other Factors	Currently Allocated (10/9/2015)	2016 CIP	2017 CIP	2018 CIP	2019 CIP	2020 CIP	2021 CIP	Total CIP 2016-2021	Project Complete within 5-Year CIP Plan
Case 1	Indian Creek	Clark Road SE	SE	No suitable overland flow path. Structures such as fences, wall, and garages encroach onto drainage easement.	Construct overland flow path. Remove encroachments	460,000	None	22	59	Policy Issue - Drainage Easement Encroachment								$ -	NO
Case 111	Rockford Road	18th Street SW south of 16th Avenue	SW	Regional detention basin required as part of development agreement	Construct Regional Detention Basin	650,000	FY2015	23	59	Previous City Commitment		$ 249,000	$ 400,000					$ 649,000	YES
Case 19	E Avenue	Vinton Ditch at E Avenue NW	NW	Ditch floods at culvert restriction, properties are within FEMA 100-year Floodplain	Construct upstream detention	2,694,204	None	24	59									$ -	NO
Case 25	Prairie Creek	12th Street SW near 32nd Avenue	SW	No overland path results in flooding of business	Construct swale in 11th street ROW from 29th Street south to 32nd Avenue. Construct culvert crossing 12th Street SW	641,000	None	25	57					$ 175,000	$ 466,000			$ 641,000	YES
Case 11	E Avenue	1st Avenue SW at Cleveland Elementary	SW	No suitable overland flow and undersized culvert crossing	Model drainage area, add additional detention, complete culvert replacement, and provide overland path as needed	5,000,000	None	26	57									$ -	NO
Case 109	E Avenue	Edgewood Road SW at 16th Avenue	SW	Overland flow flooding arterial street	Expand detention basin to reduce flow rate, increase pipe capacity under street.	500,000	None	27	55									$ -	NO
Cse 110	Kenwood	35th Street NE at Collins Plant	NE	Potential building flooding	Build berm, extend storm sewer, increase storm capacity	600,000	None	28	55									$ -	NO
Case 38?	Czech Village	6th Street SW 1200 Block	SW	Conveyance capacity limited resulting in flooded neighborhood	Construct Detention Basin	1,000,000	None	29	55							$ 85,000	$ 135,000	$ 220,000	NO
Case 114	Kenwood	D Avenue NE from 38th Street to 39th Street	NE	Localized flooding caused by undersized storm sewer	Expand storm sewer and intake capacity	250,000	FY2015	30	55		$ 30,000							$ -	NO
Case 115	Kenwood	Meadowbrook Drive SE from 22nd Street to 26th Street	SE	Aging and undersized infrastructure. Large areas with no storm sewer. Overland flow caused road damage and flooding in yards.	Replace and expand storm sewer	250,000	FY2015	31	55		$ 35,000							$ -	NO
Case 116	Kenwood	D Avenue NE From 30th Street to 32nd Street	NE	Existing storm sewer is undersized	Replace storm sewer	450,000	None	32	55									$ -	NO
Case 117	Kenwood	Grande Avenue SE from Crescent Street to Park Terrace	SE	Aging and undersized infrastructure	Replace storm sewer	500,000	None	33	55									$ -	NO
Case 120	Rockford Road	South of Jefferson High School west of 18th St SW	SW	Failed storm sewer and flooding in parking lot	Repair existing storm sewer. Install new 24-inch RCP and intakes	215,000	FY2016, Agreement with School District	34	53									$ -	YES
Case 104	Ushers Ferry	Ushers Ferry	NE	Residential development creating excessive stormwater runoff.	Construct Detention Basin	500,000	None	35	52									$ -	NO
Case 47	Czech Village	Wilson Avenue near Murdock Funeral Home	SW	Unsuitable overland flow path	Construct overland flow path through cemetery	491,000	None	36	52									$ -	NO
Case 118	Cedar River (Bel Air)	Between 38th Street and 39th Street SE	SE	Excessive overland flow	Grade overland flow pathway along the backyards	640,000	None	37	52									$ -	NO
Case 119	Czech Village	Detention basin north of Novac Ct SW	SW	Detention basin overtops causing flooding	Increase outlet pipe capacity and size of basin	1,000,000	None	38	52									$ -	NO
Case 122	E Avenue	Johnson Avenue SW from 1st Avenue to West Post Road	SW	Existing storm sewer is undersized	Replace storm sewer	300,000	None	39	52									$ -	NO
Case 167	Czech Village	10th Ave SW at 7th and 8th Street SW	SW	Area is very flat and floods numerous homes. No curb and gutter in the area.	Regrade or add curb and gutter	100,000	None	40	52									$ -	NO
Case 112	Kenwood	Cedar Lake	NE	Cedar Lake sedimentation	Remove potentially contaminated sediment	1,000,000	None	41	50									$ -	NO
Case 125	Kenwood	Blake Boulevard SE from Forest Drive to Crescent Street	SE	Aging and undersized infrastructure	Replace storm sewer	200,000	None	42	50									$ -	NO
Case 121	O Avenue	Schultz Dive NW	NW	Overland flow from Madison School and hill to the south flood houses on this and apartment complex on O Ave	Construct berm, extend storm sewer	250,000	None	43	48									$ -	NO
Case 123	Kenwood	23rd Street Drive SE East of Forest Drive	SE	Drainage issues at 23rd Street SE East of Forest Drive	Expand storm sewer to improve drainage.	150,000	FY2015	44	48									$ -	NO

304 FUND CAPITAL IMPROVEMENT PROJECT SUMMARY (Revised April 2016)

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Case 124	McLeod Run	Noelridge Park	NE	Additional stormwater detention	Construct new detention basin to reduce down stream impacts caused by new development around Collins Road	340,000	FY2015, SRF	45	48									$ -	YES
Case 40	Rockford Road	Rockford Road near Cargill Plant	SW	Excessive overland flow floods buildings	Regrade Rockford Road to address flooding from overland flow (18th Street detention basin should reduce peak flows to Rockford Road)	2,615,000	None	46	48									$ -	NO
Case 127	Prairie Creek	J Street SW north of Miller Ave	SW	Drainage channel needs clearing, flooded street	Clean drainage way	35,000	None	47	48									$ -	NO
Case 128	Kenwood	26th Street SE near Beaver Avenue	SE	Ponding water on southbound lane	Extend Storm Sewer or Regrade Road	250,000	None	48	48									$ -	NO
Case 132	Morgan Creek	Rockvalley Ln Drainage Channel	NW	Stormwater flow is causing excessive channel erosion	Bank stabilization	200,000	None	49	48									$ -	NO
Case 100	Morgan Creek	Morgan Creek	SW	Morgan Creek detention basin is undersized. No suitable overland flow path to the basin.	Grade swale for path to the basin. Increase basin capacity. Replace outlet structure	175,000	FY2016	50	47	Private Development Issue								$ -	NO
Case 133	Cedar River	Ellis Road NW	SE	Damaged outfall on Ellis Road NW	Remove 12" drain tile and replace with 24" RCP. Install an in-line flood protection valve.	67,680	2014 FEMA	51	47									$ -	YES
Case 126	Cedar River (Van Vechten)	Van Vechten Park	SE	Van Vechten Park – no name stream exposed sanitary line	Bank stabilization	50,000	None	52	45									$ -	NO
Case 14	Prairie Creek	Badger Drive SW	SW	Properties located within Floodplain	Increase storm sewer capacity and regrade drainage path	67,380	None	53	45									$ -	NO
Case 41	Rockford Road	5th Avenue SW east of Rockford Road	SW	Excessive overland flow floods buildings	Install additional intakes to tie into the large box culvert running underneath the road (Initial evaluation shows culvert meets 100-year event. upstream detention at 18th Street should help issue)	100,000	None	54	45									$ -	NO
Case 129	E Avenue	F Avenue NW at 19th Street	NW	Undersized culvert under F Avenue NW	Replace culvert	50,000	None	55	45									$ -	NO
Case 7	Prairie Creek	Handly Court SW	SW	Undersized culvert at Handley Ct SW	Replace 24" culvert with dual 18" culvert	90,000	None	56	45									$ -	NO
Case 36	Indian Creek	30th Street Drive SE	SE	Properties located within Floodplain	Assist in elevating 3 homes	266,850	None	57	45									$ -	NO
Case 130	Morgan Creek	Lakeview Drive SW north of Beverly Road	SW	Retention basin overtopping, culvert may be undersized and overland flowpath needs to be assessed	Replace or extend culvert and regrade an overland flow path	350,000	None	58	45									$ -	NO
Case 131	Prairie Creek	Bowling Street SW at Prairie Creek	SW	Flooded business	Build berm or relocate business	600,000	None	59	45									$ -	NO
Case 168	McLeod Run	West of Noelridge Park Outlet Structure	NE	The overland flow from the pond has flooded out at least one home (perhaps more).	Improve overland flow path	500,000	None	60	45									$ -	NO
Case 35	Kenwood	24th St Drive SE and 1st Avenue	SE	Isolated flooding caused by insufficient overland flow path	Extend storm sewer, or regrade overland flow path	130,000	None	61	43									$ -	NO
Case 135	Cedar River	44th Street SE south of Pioneer Trail	SE	Overland flow flood the street	Construct new culvert and minor bank work	30,000	None	62	41									$ -	NO
Case 136	Morgan Creek	Morgan Creek	SW	Washout caused by overland flow	Replace headwall and wingwall of culvert. Provide rip-rap to limit future erosion.	35,000	2014 FEMA	63	41									$ -	YES
Case 137	Cedar River (Bel Air)	Harold Drive SE at 14th Avenue	SE	Capacity limited overland flow path flooded street	Construct flow path and stabilize or increase detention	500,000	None	64	41									$ -	NO
Case 139	Prairie Creek	Miller Avenue SW east of Vermont Street	SW	Drainage channel needs clearing, flooded street	Clear drainage way	35,000	None	65	41									$ -	NO
Case 13	McLeod Run	Clifton Street NE	NE	Poor drainage due to lack of storm sewer	Extend storm sewer to mitigate drainage issue	50,000	None	66	41									$ -	YES
Case 140	Indian Creek	Green Valley Terrace SE	SE	Damaged 48-inch storm sewer	Repair storm sewer	50,000	None	67	41									$ -	NO
Case 138	Indian Creek	Savannah Court SE	SE	Topography to flat to support outlet flow from street, stagnant water and flooded residential street	Reconstruct of storm sewer	50,000	None	68	40									$ -	NO
Case 44 and 48?	Indian Creek	Skylark Lane at Red Fox Road SE	SE	Overland flow floods yards	Extend storm sewer	66,400	None	69	40									$ -	NO
Case 159	Cedar River	18th Street NW south of Ellis Road	NW	Channel erosion	Construct new piping and repair erosion	100,000	None	70	40									$ -	NO
Case 141	Indian Creek	East of 3900 block 1st Avenue	SE	Overland flow path resulting in flooded parking areas	Increase intake and storm sewer capacity	20,000	None	71	38									$ -	NO
Case 142	McLeod Run	Oriole Court NE to Finch Court	NE	Poor drainage	Extend storm sewer	150,000	None	72	38									$ -	NO

304 FUND CAPITAL IMPROVEMENT PROJECT SUMMARY (Revised April 2016)

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Case 143	Kenwood	37th Street NE and Eastern Avenue	NE	Storm sewer lacks conveyance capacity causing flooded residential streets	Extend storm sewer, increase detention	250,000	None	73	38									$ -	NO
Case 144	McLeod Run	Cavalier Street NE east of Harding School	NE	Inadequate conveyance piping, flooded residential streets	Install drain tile and extend storm sewer	250,000	None	74	38									$ -	NO
Case 145	McLeod Run	Oakland Road NE south of Elmhurst Drive	NE	Flooding occurs within the street on Oakland Road	Install new storm sewer in Oakland Road to reduce flooding and ponding of stormwater on the street	300,000	None	75	38									$ -	NO
Case 146	McLeod Run	48th Street NE west of Council Street	NE	Inadequate conveyance piping, flooded residential streets and yards	Install drain tile and extend storm sewer	350,000	None	76	38									$ -	NO
Case 147	O Avenue	Granny Smith Lane NW	NW	Overland flow at peak period floods residential road	Reconstruct overland path, reconstruct road sections to support, increase pipe capacity to receive the flow	1,400,000	None	77	38									$ -	NO
Case 150	Czech Village	A Street SW near landfill	SW	Damaged storm sewer outfall	Replace 12-inch DIP storm sewer and reconstruct berm with compacted clay and rip-rap.	31,443	2014 FEMA	78	38									$ -	YES
Case 152	McLeod Run	McLeod Run banks near 42nd Street NE	NE	Bank erosion	Bank stabilization	150,000	None	79	38									$ -	NO
Case 170	E Avenue	Franbrook Terrace at Edgewood Rd	NW	Excessive pond from street	N/A	50,000	None	80	38										NO
Case 148	Cedar River (Bel Air)	Between 38th Street and 39th Street SE	SE	Excessive overland flow	Fill eroded areas, stabilize, and remove debris.	40,000	2014 FEMA	81	36									$ -	YES
Case 149	Czech Village	20th Avenue SW north of Wilson Hy-Vee	SW	Overland flow floods backyards	Modification to inlet structure	25,000	None	82	34									$ -	NO
Case 153	Cedar River (Apple Mesa)	J Avenue NE east of Adirondack Drive	NE	Conveyance limited resulting in street flooding	Construct new culvert and minor bank work	10,000	None	83	34									$ -	NO
Case 154	Cedar River (Van Vechten)	Otis Road SE	SE	Undersized culvert resulting in flooded street	Complete hydraulic modeling. Construct new culvert and minor bank work	50,000	None	84	34									$ -	NO
Case 156	Ushers Ferry	Riverview Road NE west of Miller Road	NE	Channel overtops flooding backyards	Bank stabilization	100,000	None	85	34									$ -	NO
Case 157	Indian Creek	34th Street Drive SE from 1st Avenue to Indian Creek	SE	Poor surface water drainage	Increase capacity of existing storm sewer	300,000	None	86	34									$ -	NO
Case 158	McLeod Run	H Avenue NE to Center Point to I Avenue	NE	Poor drainage	Expand storm sewer to increase capacity and improve drainage from H to Center Point and from Center Point to I Avenue	400,000	None	87	34									$ -	NO
Case 160	O Avenue	Alley between L Ave and K Ave West of Ellis Blvd	NW	Alley is flat resulting in poor drainage	Extend storm sewer	50,000	None	88	34									$ -	NO
Case 162	McLeod Run	G Avenue NE at Center Point Road	NE	No conveyance systems resulting in ponding on arterial street	Extend storm sewer to the location	750,000	None	89	28									$ -	NO
Case 163	McLeod Run	Brookland Drive NE	NE	Insufficient storm sewer capacity causing backyard flooding	Replace storm sewer	1,000,000	None	90	28									$ -	NO
Case 164	Cedar River	Old River Rd SW	SW	Failed culvert headwalls	Replace headwalls	51,684	None	91	28									$ -	NO
Case 165	Indian Creek	40th Street Drive SE	SE	Bank erosion	Bank stabilization	150,000	None	92	28									$ -	NO
Case 166	Kenwood	Cedar Lake	NE	North end of Cedar Lake into Cedar River outlet structure reduced flow to river	Remove sediment, fix structure	150,000	None	93	28									$ -	NO
Case 161	Cedar River	Robbins Lake at Ellis Road NW	NW	Sedimentation from stream along Edgewood Rd affecting fish habitat	Pump out, remove sediment, restock	250,000	None	94	24									$ -	NO
												$ 2,350,000	**$ 2,340,000**	**$ 2,100,000**	**$ 2,150,000**	**$ 2,210,000**	**$ 2,260,000**	**$ 12,760,000**	**$ -**

Attachment C - NRCS National Soil Database

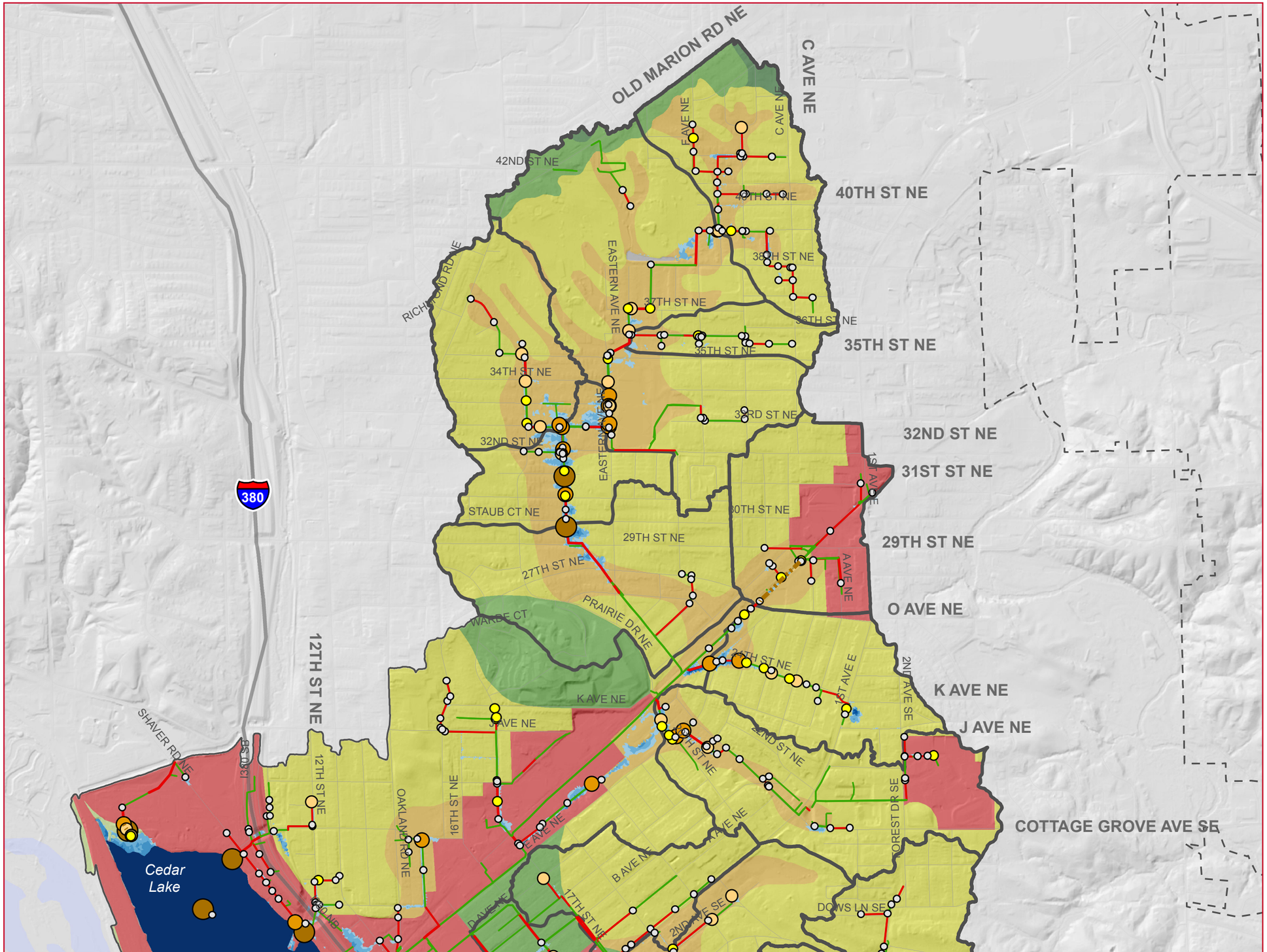


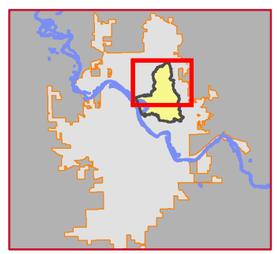
FIGURE 6
HYDROLOGIC SOIL GROUPS
KENWOOD CATCHMENTS - NORTH

- City Boundary
- Open Channel
- Project Area Catchment
- Storm Pipe
- Full - Bottleneck Pipe

Overflow Manholes (Acre-Feet)

- >0 - 0.5
- 0.5 - 1
- 1 - 2
- 2 - 5
- >5

Ponding Depth (ft)	Hydrologic Soil Group
0.5 - 1.0	A
1.1 - 2.0	B
2.1 - 3.0	B/D
3.1 - 4.0	C
4.1 - 5.0	C/D
5.1+	D



0 Feet 1,400

DATA SOURCE: City of Cedar Rapids

HDR

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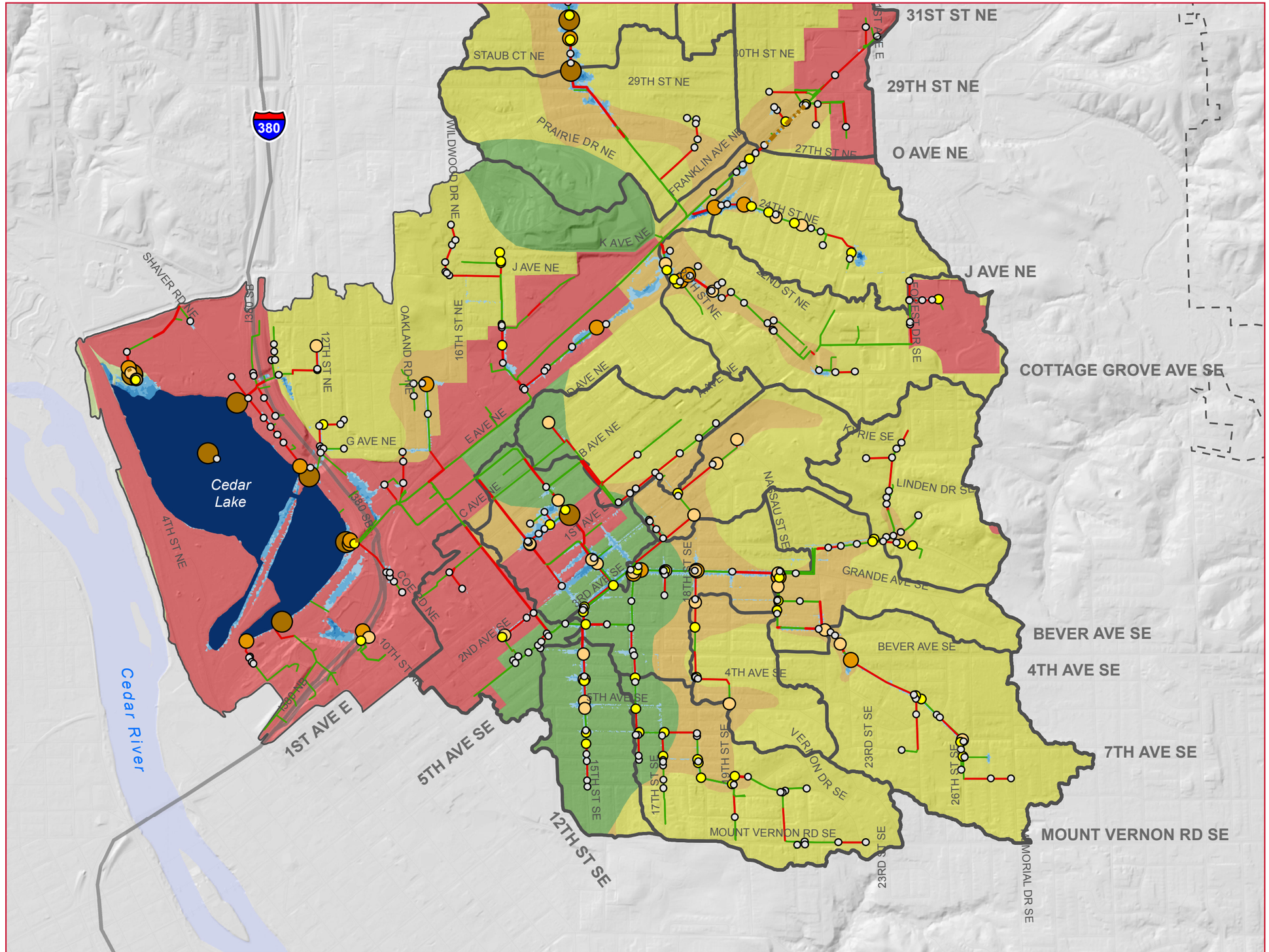
PATH: Z:\PROJECTS\258297-CR_STROMWATER_MASTER_PLAN\MAP_DOCS\MXD\TM_3\MICRO\CR_KENWOOD_SEC_SOILS_NORTH.MXD - USER: WWHEELER - DATE: 1/26/2016

FIGURE 7
HYDROLOGIC SOIL GROUPS
KENWOOD CATCHMENTS - SOUTH



City Boundary

Open Channel

Project Area Catchment

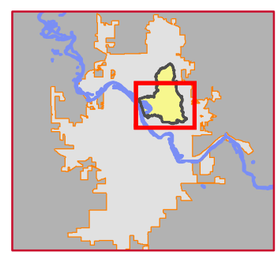
Storm Pipe

Full - Bottleneck Pipe

Overflow Manholes (Acre-Feet)

- >0 - 0.5
- 0.5 - 1
- 1 - 2
- 2 - 5
- >5

Ponding Depth (ft)	Hydrologic Soil Group
0.5 - 1.0	A
1.1 - 2.0	B
2.1 - 3.0	B/D
3.1 - 4.0	C
4.1 - 5.0	C/D
5.1+	D



0 Feet 1,400

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PATH: Z:\PROJECTS\258297-CR_STROMWATER_MASTER_PLAN\MAP_DOCS\MXD\TM_3\MICRO\CR_KENWOOD_SEC_SOILS_SOUTH.MXD - USER: WWHEELER - DATE: 1/26/2016